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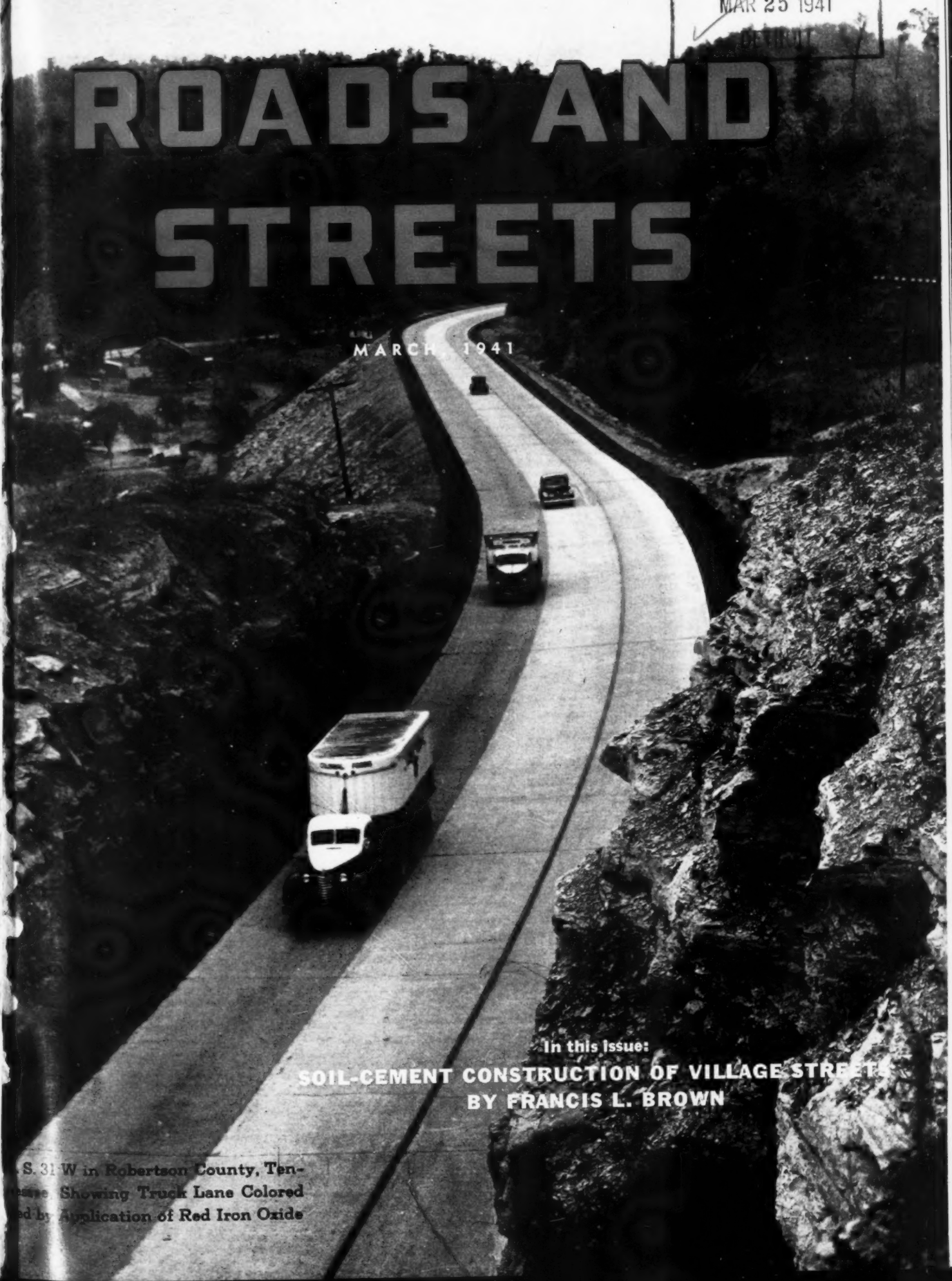
ROADS AND STREETS

MARCH, 1941



In this issue:

SOIL-CEMENT CONSTRUCTION OF VILLAGE STREETS
BY FRANCIS L. BROWN

S. 31W in Robertson County, Tennessee Showing Truck Lane Colored by Application of Red Iron Oxide

HARD WET CLAY or SILT -You Get A Load!

***NEW*— Adams Power Control Unit**
Adaptable to any tractor and will handle any scraper up to 15 cu. yds. Entirely different . . . has a lot of new operating advantages. Ask your Adams representative about it.

DOES IT LOAD EASILY . . . QUICKLY . . . AND FULL? That's your first concern about a hauling scraper. Their ability to get good pay loads in all types of material is the first thing you are going to like about Adams Hauling Scrapers. Their easy loading ability is due first, to a drop-center bowl which penetrates the ground quickly; second, to balanced distribution of material while loading; and, third, to the shape of the bowl into which material does not have to be pushed back as far or lifted as high to get capacity—two factors which consume time and power with other scrapers. . . .

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Cast-in-place vertical Reflecting Curb on New Jersey Route 35 in a location illuminated by overhead lights. Curb made with Atlas White portland cement. Contractor, Jannarone Contracting Co., Belleville, N. J.; Curb Manufacturer, Frapaul Construction Co., Inc., Hackensack, N. J.

THE BLACKER THE NIGHT THE BRIGHTER IT GLEAMS

HERE'S a startling story of increased visibility for night drivers with White Concrete Reflecting Curb.

This photograph, taken on a dry night under car headlights and in a location illuminated by overhead lights, shows how effectively this vertical type of White Concrete Reflecting Curb defines the roadway far ahead of the speeding car. On dark rainy nights when visibility is practically nil, this new curb is even brighter than on dry nights and provides an even brighter guide to safety.

The scientifically designed saw-tooth faces of this amazing new curb catch and reflect the headlight rays back to the driver. White concrete made with Atlas White Cement provides sharp contrast in daytime and a permanent white surface that increases the intensity of the reflected light at night.

In many locations in a number of states the efficiency of Reflecting Curb is increasing driving safety and comfort.

* * *

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Placing side form for vertical reflecting curb. This produces the outer curb facing which will have the saw-tooth, light-reflecting surface. Except for form costs which may be charged off to many miles of curb, White Concrete Reflecting Curb costs little more than ordinary smooth-troweled curb. But what a difference there is in visibility!

RS-M-18

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ROADS and STREETS

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Vol. 84 MARCH, 1941 No. 3

CONTENTS

◆ ◆

Soil Cement Construction of Village Streets, Granville, N. Y. 31
By FRANCIS L. BROWN
Consulting Engineer

Municipal Regulation of Curb Cuts and Service Driveways 34

Keep Performance Records 37

Observations by the Way 38

Correlation of Plasticity Index and Liquid Limit with Stability 40
By L. A. DEKLOTZ
Portland, Oregon

Patching Spalled Areas with Cement Mortar 46

Private Suspension Toll Bridge Collapses 52

Rebuilding Coastal Route in Mississippi 54
By G. WALTON THOMPSON
Project Engineer, Mississippi State Highway Department

Airports Runway Surfaces 62
By H. H. HOUK
Engineer, Washington National Airport

Effect of Grading and Admixtures on Compressive Strength and Capillary Water Absorption of Soil Base Course Mixtures 64
By J. B. GARNEAU and C. E. BELAND
Respectively Chief Chemist and Assistant Chief Chemist Quebec Highway Department

Readers Comments 82

Editorial 83

New Equipment and Materials 84

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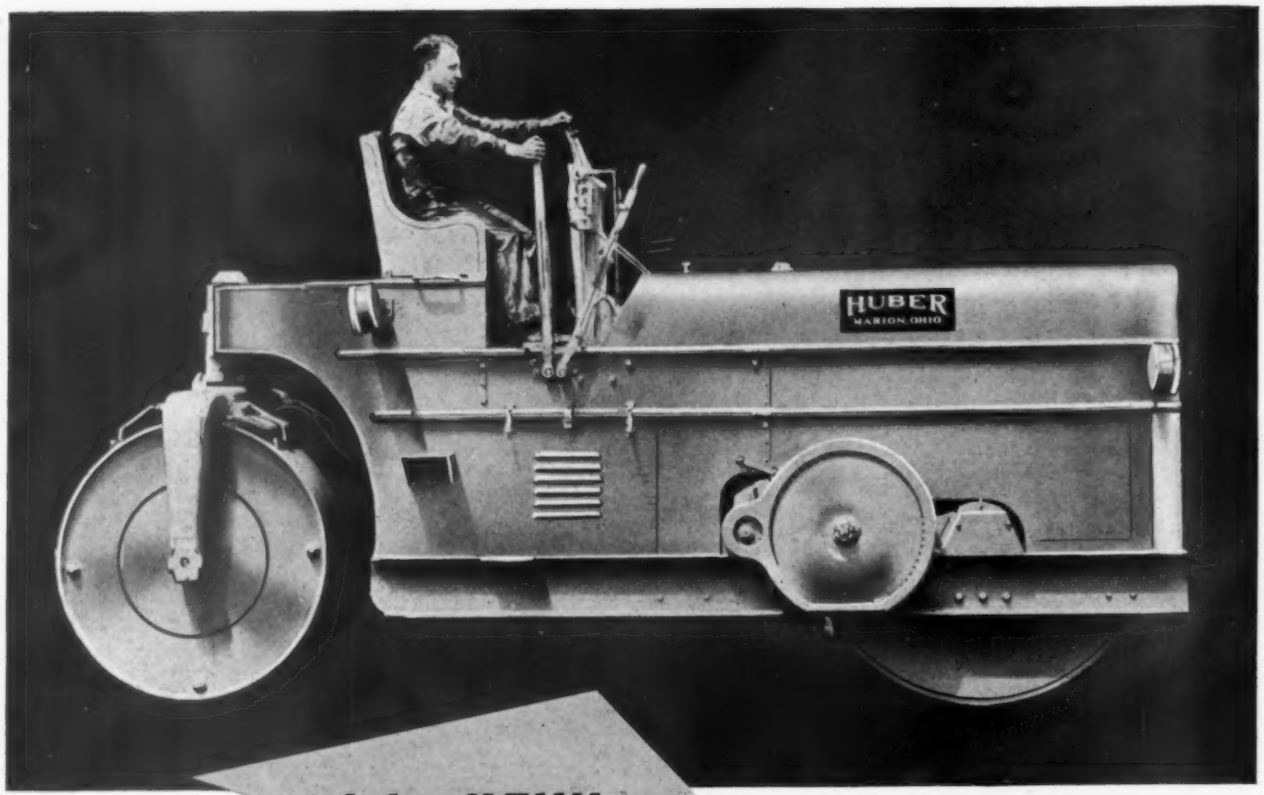

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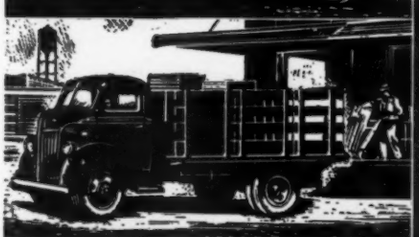

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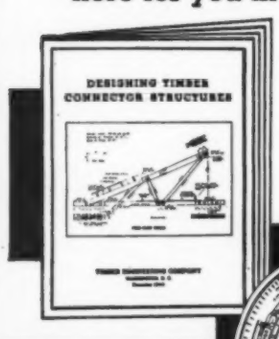

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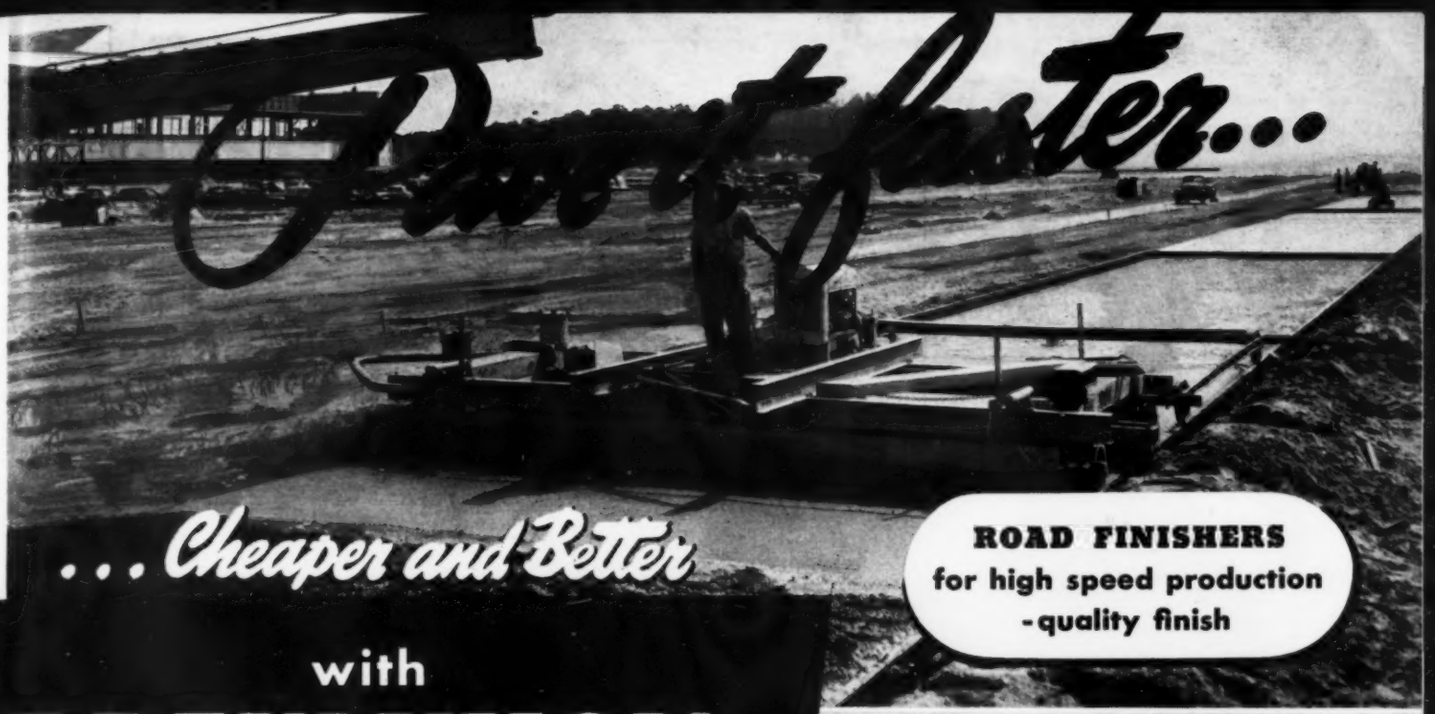

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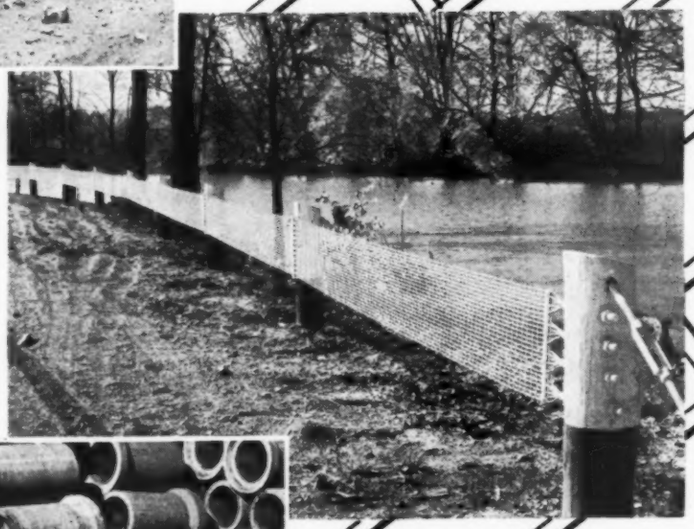

Maximum structural strength is imparted to concrete pipe by the embedment in the concrete of ***Pittsburgh Reinforcement.*** Extending invisibly from end to end, this "hidden asset" inhibits cracking and binds the concrete into monolithic cylinders. They withstand great external pressure, lay without breaking, and assure long, low-cost service. ***Pittsburgh Reinforcement*** is made in gauges and wire spacings to meet all concrete pipe reinforcing specifications. Available for prompt delivery.

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Welded Wire Reinforcement Fabric performs an increasingly important function in modern construction.

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Mobility	82
Low operating cost	35
Light weight	35
Ease of handling in close quarters	31
Durability	29
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Ease of operation	16
Efficient lubrication system	13
Fast swinging and hoisting	12
Adaptability to odd jobs	10
Compactness	7
Quick convertibility	6
Stability of machine	5

A85

From this report, it's easy to see why the 10-B is such a versatile road tool. Performance has made it the fastest-selling excavator in the world. You'll find it will stretch your road dollars farther; give you a single tool that will handle the full range of your road work. Investigate the 10-B for better roads at lower costs.

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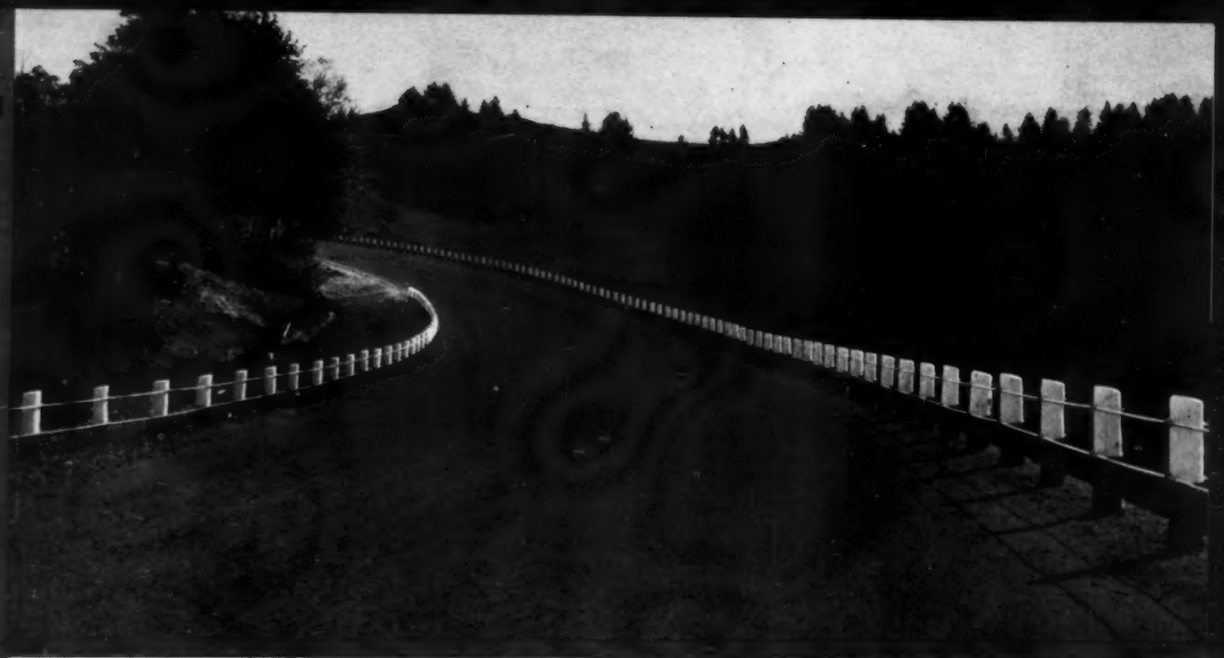

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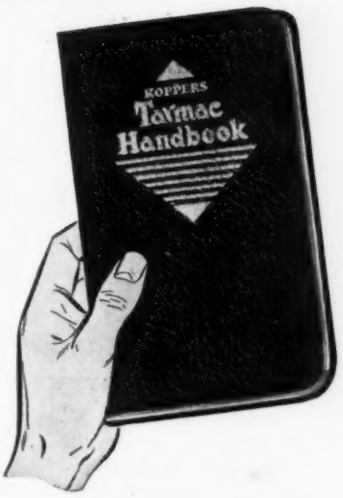

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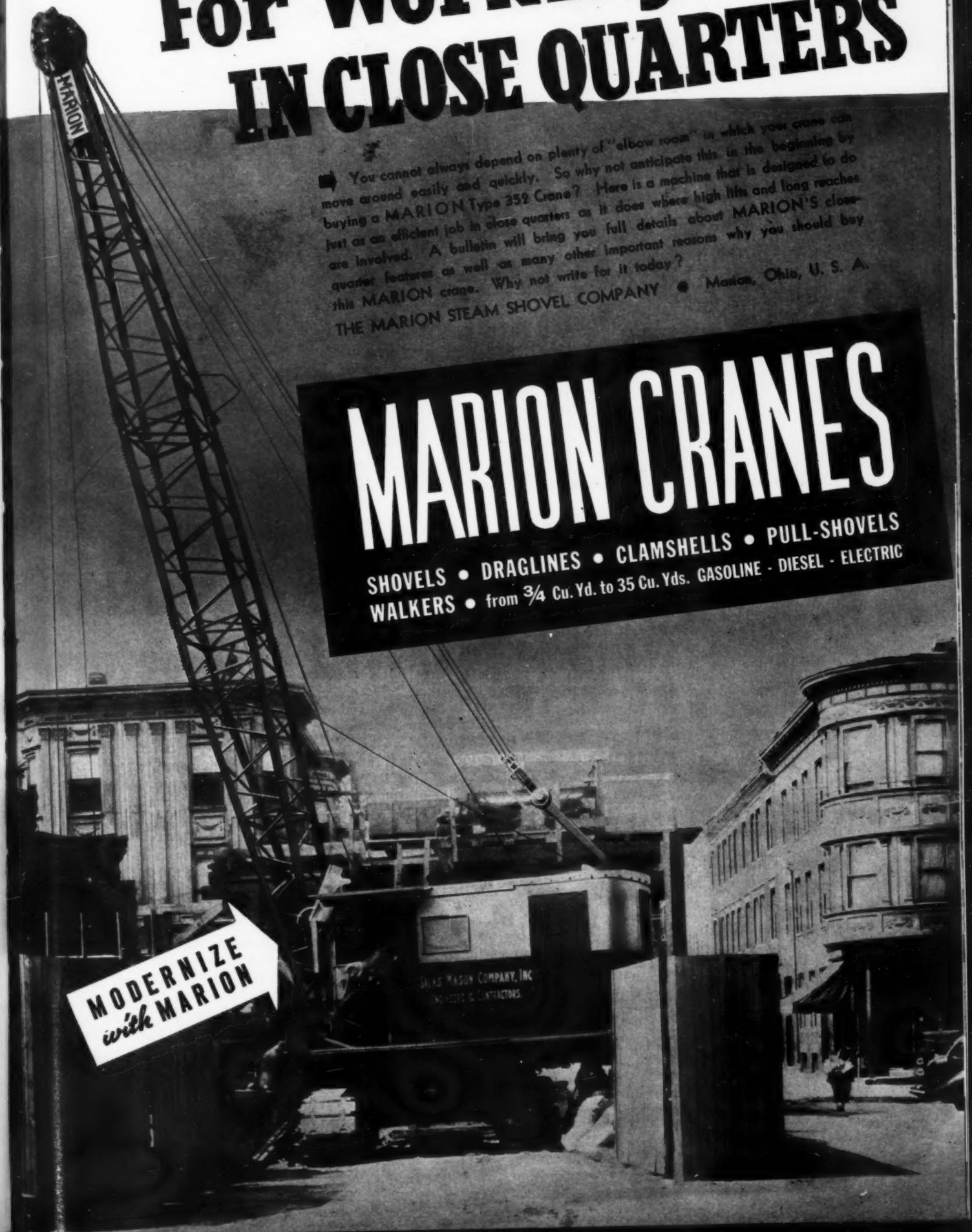
EXPERIENCE *builds them* PERFORMANCE *sells them*

For Working IN CLOSE QUARTERS



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For real Diesel economy and performance, choose the International ID-6, shown here with road grader.

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. . . and the New INTERNATIONAL-A
HIGHWAY
MOWER
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INTERNATIONAL HARVESTER COMPANY
180 North Michigan Avenue, Chicago, Illinois

INTERNATIONAL

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The new International WHEEL Tractors are capable of operating a variety of equipment in their power range. This includes maintainers and graders; front-end shovels and loaders; cross-walk, side-walk, and other types of snow plows; road rollers; cranes and hoists; winches; brushes and sweepers; disk harrows and mixers for mixed-in-place roads; scrapers; dump wagons; trailers; tampers; mowers; etc.

"I" Tractor Facts at a Glance

I-4—4-cylinder valve-in-head gasoline engine. Bore and stroke 3⅜ x 4¼ inches. Five forward speeds up to 15 m.p.h. Develops 29.5 engine h.p. at 1,650 r.p.m.

I-6—4-cylinder, valve-in-head gasoline engine. Bore and stroke 3⅞ x 5¼ inches. Five forward speeds up to 14 m.p.h. Develops 40.5 engine h.p. at 1,450 r.p.m.

ID-6 DIESEL—Quick-starting, 4-cylinder, compression-ignition, 4-cycle Diesel engine. Bore and stroke 3⅞ x 5¼ inches. Five forward speeds up to 14 m.p.h. Develops 38.5 engine h.p. at 1,450 r.p.m.

I-9—4-cylinder, valve-in-head gasoline engine. Bore and stroke 4.4 x 5.5 inches. Five forward speeds up to 15 m.p.h. Develops 54 engine h.p. at 1,500 r.p.m.

ID-9 DIESEL—Quick-starting, 4-cylinder, compression-ignition, 4-cycle Diesel engine. Bore and stroke 4.4 x 5.5 inches. Five forward speeds up to 15 m.p.h. Develops 51.5 engine h.p. at 1,500 r.p.m.

Industrial Power

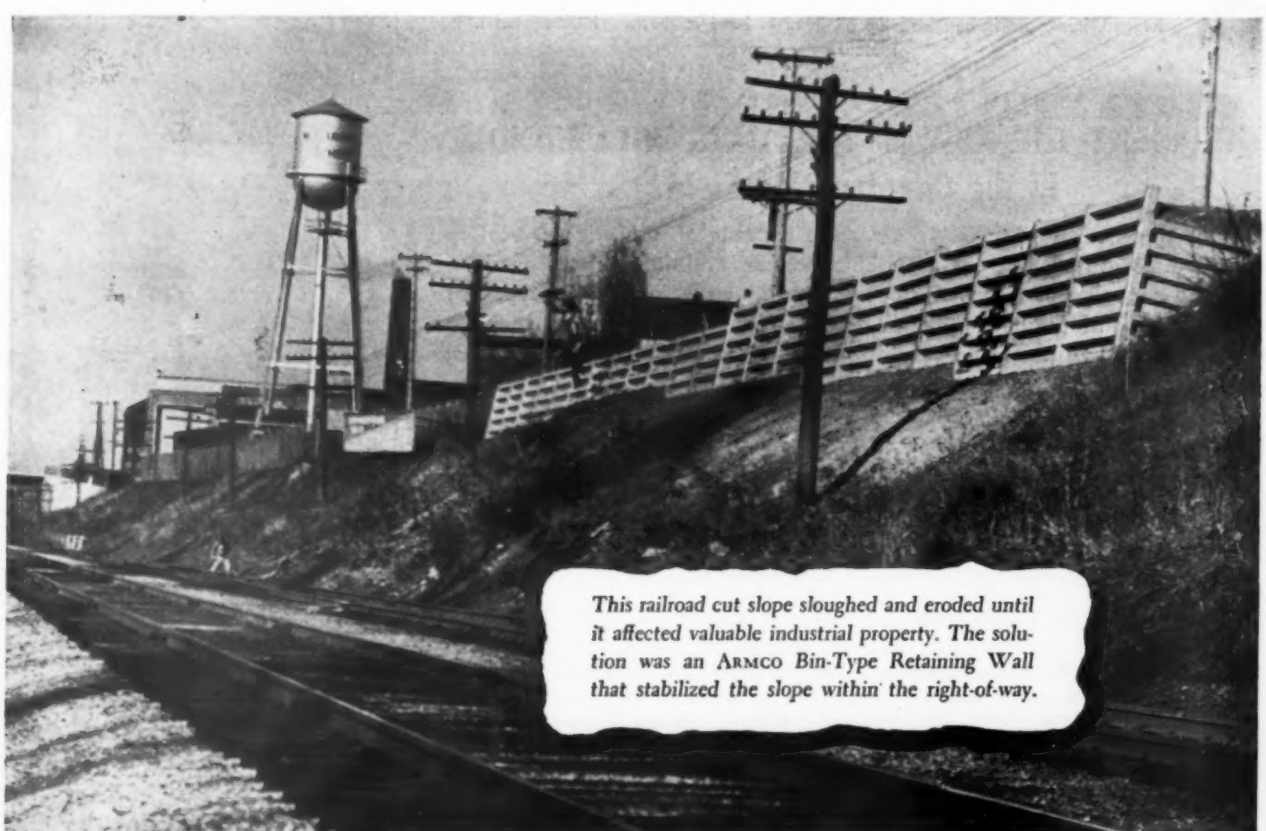
How to Gain More Space-

Without Expanding!

When defense orders raised production to flood tide, this industrial plant found that it needed more space quickly. There was land available within the property line but an unstable railroad cut slope made it just waste space. Fortunately the railroad had a ready answer. An ARMCO Bin-Type Retaining Wall was quickly erected and now the land is permanently restored for use.

Many engineers and construction men see ARMCO Walls as the practical solution to unstable earth problems. Efficiency and economy go hand in hand. An ARMCO Wall is so easy to erect that unskilled men can do it in any season. Little excavation is the rule. Backfilling is done as the job progresses and undermining during construction is arrested. No danger of cracking or bulging. ARMCO Walls are based on sound engineering design and have the strength and flexibility to overcome unequal settlement.

Use an ARMCO Bin-Type Retaining Wall when you want speed of erection, strength and economy. You'll find it a ready solution for unstable slopes, right-of-way, stream erosion and similar problems. Tell us about that next job and we'll send you specific information. ARMCO DRAINAGE PRODUCTS ASSOCIATION, 5031 Curtis St., Middletown, Ohio.



This railroad cut slope sloughed and eroded until it affected valuable industrial property. The solution was an ARMCO Bin-Type Retaining Wall that stabilized the slope within the right-of-way.

ARMCO Bin-Type Retaining Walls

8 more contractors turn to P&H

The word's going around! More and more contractors are recognizing the advantages of rolled alloy steel construction for all kinds of digging. Here are 8 more well-known firms who have recently bought new P&H's:

J. L. Boyle Engineering & Contracting Co., Newark, N. J.

Hempt Bros., Camp Hill, Penn.

George M. Brewster, Bogata, N. J.

R. C. Mahon Company, Detroit, Mich.

Duval Engineering & Contracting Co., Jacksonville, Fla.

C. F. Braun & Company, Alhambra, Calif.

Gifford Hill & Company, Dallas, Texas

Nelson, Mullen & Webster, Inc., Minneapolis, Mini

1500 Rolled Alloy Steel EXCAVATORS HAVE CONCLUSIVELY PROVED THAT P&H'S MODERN DESIGN IS FAR AHEAD . . . . . Superior

General Offices: 4496 West National Avenue, Milwaukee, Wisconsin

HARNISCHFEGER
CORPORATION

EXCAVATORS • ELECTRIC CRANES • ARC WELDERS (P&H) HOISTS • WELDING ELECTRODES • MOTORS

You'll save time!

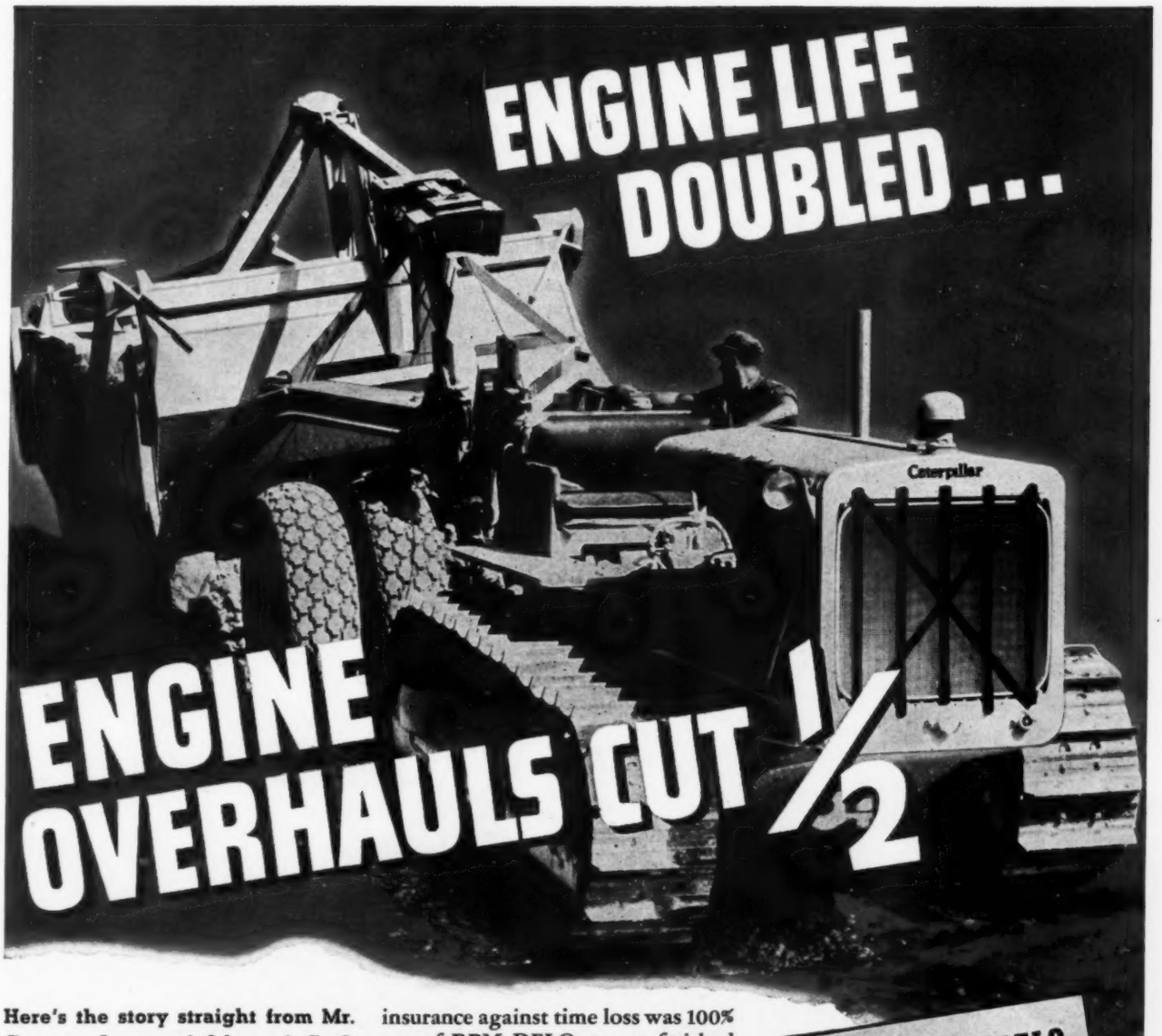
Instead of ordering bar mats and reinforcing bars from one source, road joints and steel posts from another, and so on, why not save time and trouble by ordering every road steel need from one source—Bethlehem?

That way you save: Phone bills, bookkeeping, accounting, correspondence expense. Then, from one of Bethlehem's 15 strategically-located warehouses, or alert jobbers, you'll get deliveries complete, on time. No waiting around on the job for some key item that's lost, strayed, or just delayed.

Call the nearest Bethlehem office for details of Road Steel Service.

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL



Here's the story straight from Mr. George Langenfelder of C. J. Langenfelder and Son, prominent Baltimore Contractors:

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"We recently completed a job on the Pennsylvania Turnpike involving the moving of nearly 2,000,000 yards of rock, shale and dirt. Our contract called for completion in 270 calendar days; if we ran over, heavy penalties were imposed. Our insurance against time loss was 100% use of RPM DELO, so we finished ahead of schedule.

"We own and operate 28 Caterpillar Diesels... 3 Waukesha-Hesselman engines... 4 Mack-Lanova Diesels... 9 Cummins Diesels... 44 units, which to us represent 44 reasons why we use RPM DELO exclusively!"

ORDER RPM DELO
Unequaled
FOR YOUR DIESELS

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RPM DELO
Diol RPM DELO
Kyso RPM DELO
Sohio RPM DELO
Signal RPM DELO
Imperial RPM DELO

Ask your Diesel engine manufacturer or distributor for the RPM DELO supplier in your locality.

RPM DELO
REG. TRADE-MARK
DIESEL ENGINE LUBRICATING OIL

STANDARD OIL COMPANY OF CALIFORNIA

LIMA SUPER PAYMASTER IS PROOF OF LEADERSHIP

■ ■ ■

The SUPER-PAYMASTER, a ¾ yard combination shovel, dragline, crane and pull shovel recently developed by the Lima Locomotive Works, Incorporated, Shovel and Crane Division, Lima, Ohio, is a major contribution to the efficiency and profitable operation of the earth moving and material handling industry. Its design embodies the same time-tested features that made its predecessor, the PAYMASTER, so unusually popular with its many users. When equipped as a clamshell or dragline, capacity depends upon length of the boom and material to be handled. When equipped as a crane, it is of 13 ton capacity. As a shovel, it is equipped with an 18′ boom and a 15′ dipper handle. It is exceptionally fast with ample strength to give steady dependable service in all kinds of work. Many new features which are worth consideration are found in its design.

LIMA LOCOMOTIVE WORKS, INCORPORATED LIMA, OHIO

Shovel and Crane Division

NEWARK, N. J. NEW YORK, N. Y. DALLAS, TEXAS PORTLAND, ORE.
MEMPHIS, TENN. SAN FRANCISCO, CALIF. SEATTLE, WASH.
LOS ANGELES, CALIF. PHILADELPHIA, PA. SPOKANE, WASH.
MONTREAL, QUEBEC, CANADA
VANCOUVER, B. C.

EVERYTHING YOU WANT IN A ¾ YD. EXCAVATOR

PROPER BALANCE
Proper balance is particularly stressed in the SUPER-PAYMASTER. The machinery and power plant is placed to the extreme rear of the rotating frame so that greater capacities can be obtained without affecting the weight of the machine.

HOOK ROLLERS
Hook rollers relieve center pintle of all digging shocks. They rotate between a double roller path cast integral with the lower frame casting.

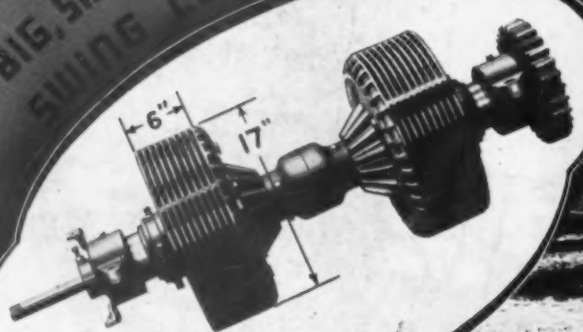
LARGE SWING CLUTCHES
The swing clutches are the internal expanding band type, toggle operated, with housings 17″ in diameter by 6″ wide. The unusual size of the clutches assure smooth, split-hair control. No time lost in spotting the load—no overheating – no complicated adjustments.

ANTI-FRICTION BEARINGS
Friction is reduced to a minimum by the use of anti-friction bearings which are used at all the important bearing points, including drums.

EASE OF CONTROL
The SUPER-PAYMASTER responds instantly to all control levers which are within easy reach and are of short easy throw. One of the chief considerations of Lima Engineers in designing this unit was the operator.

CLEAR VISION CAB
The cab is equipped with a winter-front which is housed in top of cab when not in use, and it can easily be lowered or raised with one hand. No other cab offers so great a range of vision.

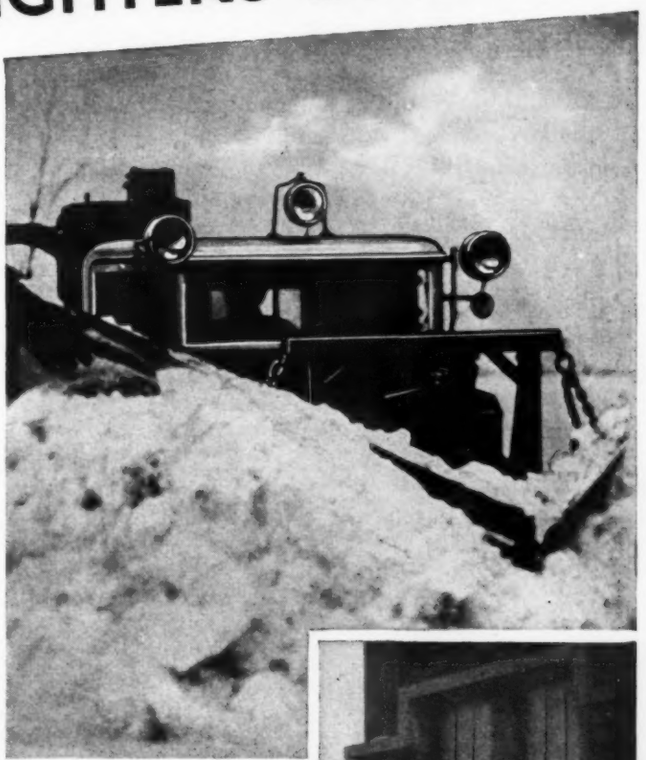
BIG, SMOOTH RUNNING SWING CLUTCHES



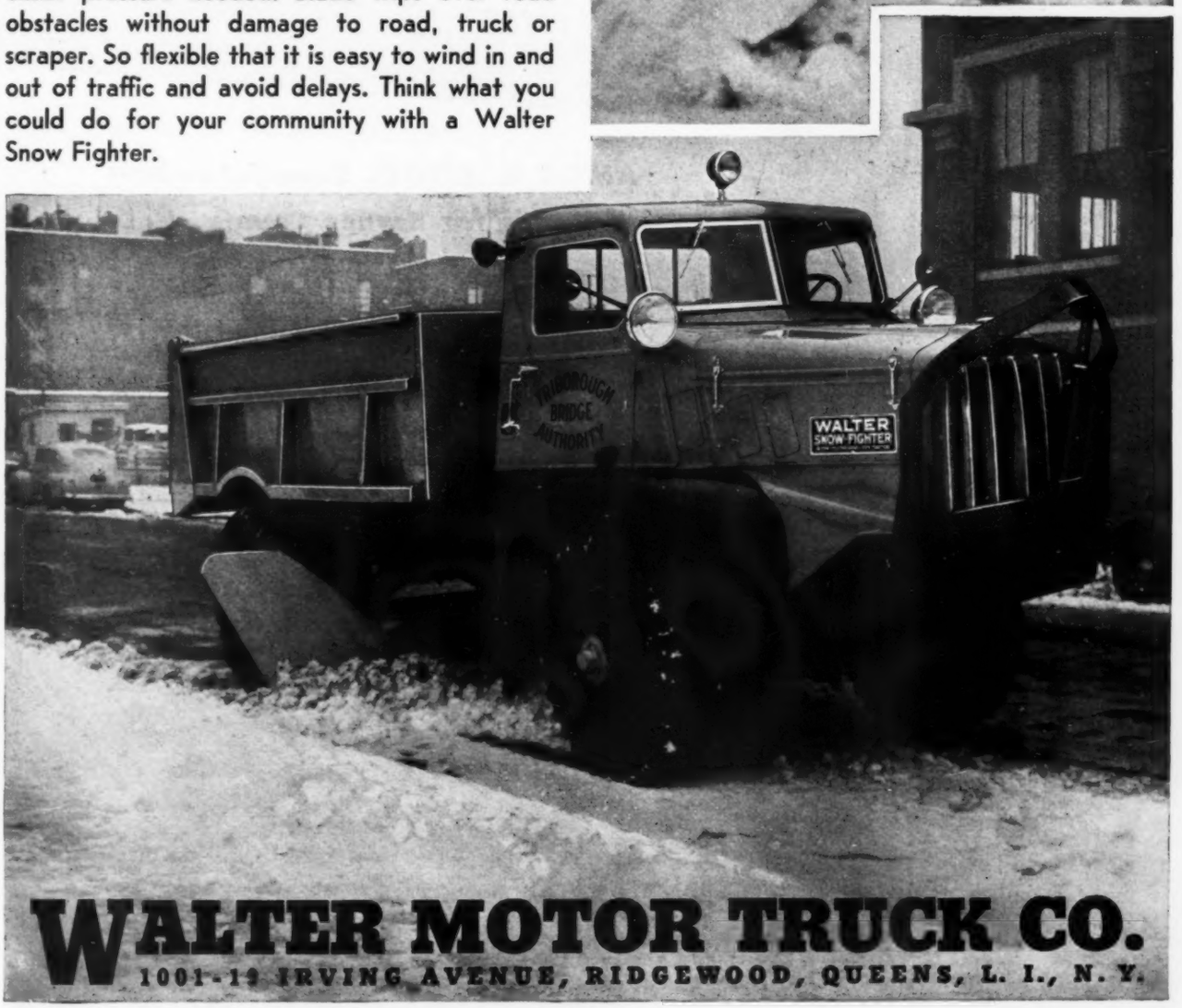
LIMA SUPER Paymaster 3/4 YD.

SHOVEL • CRANE • DRAGLINE • CLAMSHELL • TRUCK CRANE • PULL-SHOVEL

WALTER SNOW FIGHTERS do the job from top to bottom



Have you ever tried to peel hard-packed snow and ice off the pavement with a motor truck and center scraper? "Can't be done," you say? But it ***can*** be done—with a Walter Snow Fighter, equipped with Walter Center Scraper. The same wonderful Four-Point Positive Drive that has made this unit famous for its work in deep snow, makes it unequalled for scraping. Automatic Lock Differentials, Suspended Double Reduction Drive, High Ground Clearance, Tractor Type Transmission and other features insure smooth, steady scraping action. You can apply safely the exact pressure needed. Blade trips over road obstacles without damage to road, truck or scraper. So flexible that it is easy to wind in and out of traffic and avoid delays. Think what you could do for your community with a Walter Snow Fighter.



WALTER MOTOR TRUCK CO.

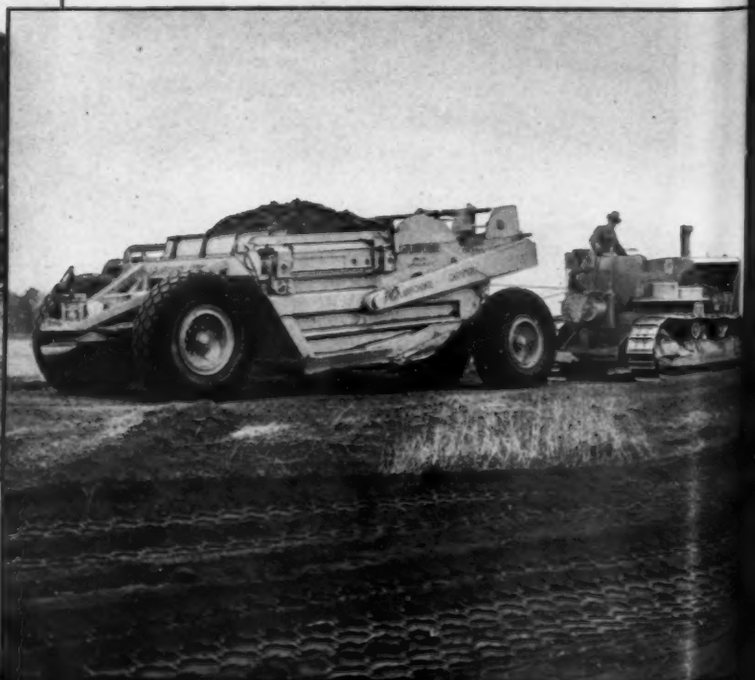
1001-19 IRVING AVENUE, RIDGEWOOD, QUEENS, L. I., N. Y.

"WE OPERATE 100% 'CATERPILLAR' EQUIPMENT ON OUR CONSTRUCTION JOBS AND FIND OUR COST IS VERY LOW"

· **AMOS E. ROOD,** ***Superintendent of Roads for Barnes County, N. D.***

• *Barnes County's "Caterpillar" Diesel* D8 *Tractor with a LaPlant-Choate Carrimor scraper. 300-foot haul here. Average load is* 13 *yards. The "Caterpillar" Diesel works* 10 *hours a day. Uses* 4 4/10 *gals. of* 9 3/10c *fuel an hour!*

• *A "Caterpillar" Diesel* D8 *Tractor and a "Caterpillar" No.* 48 *Elevating Grader build a new road that will take advantage of the winds and clear itself of snow in Winter. This outfit, and the other two "Caterpillar" Diesel outfits shown herewith, handled the entire construction of this* 26*-mile section of new road for Barnes County, N. D.*



THERE are many things that make your costs low when you operate with "Caterpillar" Diesel equipment! First of all, you get *more than ordinary Diesel economy*—through the ability of these machines to operate efficiently on the low-priced, non-premium grades of Diesel fuel!

You get low maintenance-repair expense—in spite of steady going and long going—through the heavy-duty construction of "Caterpillar" Diesels, including the use of "Hi-Electro" hardening for track roller-rims and shafts, track pins, cylinder liners, crankshaft and other parts that have to fight the hardest and most wear.

You've got time-saving helps: a fuel system without operating adjustments . . . a power-controlled, revolving, high-reach, wide-reach motor-grader blade . . . easy maneuverability in the tractor.

And, finally, consider the versatility of "Caterpillar" Diesel equipment: Its ability to handle practically *every* phase of road work. This saves you the cost of buying and maintaining a fleet of "specializers" that are apt to stand idle much of the time because they don't fit the job. And it gives you the advantage of "Caterpillar" Diesel economy all around the county, all around the year; on new-road construction, new-road repair, snow removal and routine maintenance!

Now is the time to get your "Caterpillar" Diesel equipment . . . put it on your roads this Spring . . . *and start saving!*

CATERPILLAR TRACTOR CO., PEORIA, ILL.

• *The largest of three sizes of "Caterpillar" Diesel Motor Graders. This No.* 12 *is also owned by Barnes County. Working* 10 *hours a day on about* 2 *gallons of* 9 3/10¢ *fuel an hour. Covering* 1 *mile per hour, round trip.*

CATERPILLAR DIESEL

REG. U.S. PAT. OFF.

ENGINES AND ELECTRIC SETS • TRACK-TYPE TRACTORS • ROAD MACHINERY

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This book was planned and compiled expressly for use by contractors, engineers and highway officials.

It is not a textbook, but is a compendium of data carefully selected with reference to their usability by highway builders and other persons concerned with highway construction costs.

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All major articles carry descriptions to show clearly the class of work and the methods for which costs are given, and to provide a basis for further reference and study if desired.

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Outline of Contents

CHAPTER 1. INTRODUCTION—Brief discussions of construction costs, prices, profits and the uses of cost data.

CHAPTER 2. COST INDEXES—Indexes of the U. S. Public Roads Administration and Interstate Commerce Commission, with brief explanations of their construction, uses and limitations.

CHAPTER 3. OVERHEAD COSTS—Separate discussions of the overheads incurred by contractors and by states, counties and cities.

CHAPTER 4. ENGINEERING—Data from states, cities and other sources on the costs of various kinds of surveys and other engineering. There are brief articles on aerial surveys and seismographic soil and rock surveys.

CHAPTER 5. RIGHT-OF-WAY—A general discussion followed by records of actual experience and costs.

CHAPTER 6. EQUIPMENT—This chapter contains several rental and ownership expense schedules in full detail, followed by articles on operating and maintenance costs, including records of fuels, lubricants, etc., a mathematical analysis of the problems of selecting and retiring machines, and a table of depreciation rates.

CHAPTER 7. LABOR—Schedules of established minimum wage scales and records of wage rates in various states; comparisons of contract work and day labor; convict labor costs and other pertinent matter.

CHAPTER 8. CLEARING AND GRUBBING—Records of clearing with tractor-mounted equipment, hand and horse methods, stump blasting, etc.

CHAPTER 9. GRADING—Eighty-four pages of articles on grading with power shovels, scrapers of various types and sizes, elevators, blade graders, bulldozers, etc.; hydraulic grading; rock drilling and blasting; winter grading; special swamp grading; minor operations and hand work.

CHAPTER 10. HAULING AND HANDLING MATERIALS—Studies of hauling operations on power shovel jobs, concrete construction and bituminous construction; truck movements at yards; industrial railways; team and wagon hauling; and other articles.

CHAPTER 11. PRODUCTION OF AGGREGATES—Articles on labor requirements and costs of producing sand, gravel and crushed stone at various locations.

CHAPTER 12. UNTREATED BASES AND SURFACES—Waterbound macadam, crushed rock and gravel construction.

CHAPTER 13. STABILIZATION OF BASES AND SURFACES—This chapter is devoted chiefly to work with calcium chloride, articles on portland cement and bituminous stabilization being given in the chapters on concrete and bituminous construction.

CHAPTER 14. BITUMINOUS SURFACES AND BASES—The five parts of this long chapter contain articles on various methods in different states. Part 1, Surface Treatments; Part 2, Bituminous Macadam; Part 3, Mixed-in-Place Construction; Part 4, Traveling Plant Construction; Part 5, Stationary Plant Construction.

CHAPTER 15. CONCRETE SURFACES AND BASES—Contains numerous detailed records of construction. There are articles on work with 27-E pavers, 34-E pavers, tandem set-ups, batching, hauling, curing, joints, cement-bound macadam, soil-cement roads, stabilization, and other subjects.

CHAPTER 16. BRICK PAVEMENTS—Records of brick pavement construction from various cities and states, including an article on vibrated monolithic. Short references to granite block.

CHAPTER 17. SIDEWALKS, CURBS AND GUTTERS—Miscellaneous prices and details of construction.

CHAPTER 18. WALLS, FENCES AND GUARD RAILS—A brief chapter of data on these items of highway construction.

CHAPTER 19. BRIDGES AND CULVERTS—Cost data on a large number of steel, concrete and timber bridges and grade separations—also culverts of various types. There are two articles on pump installations for underpass drainage.

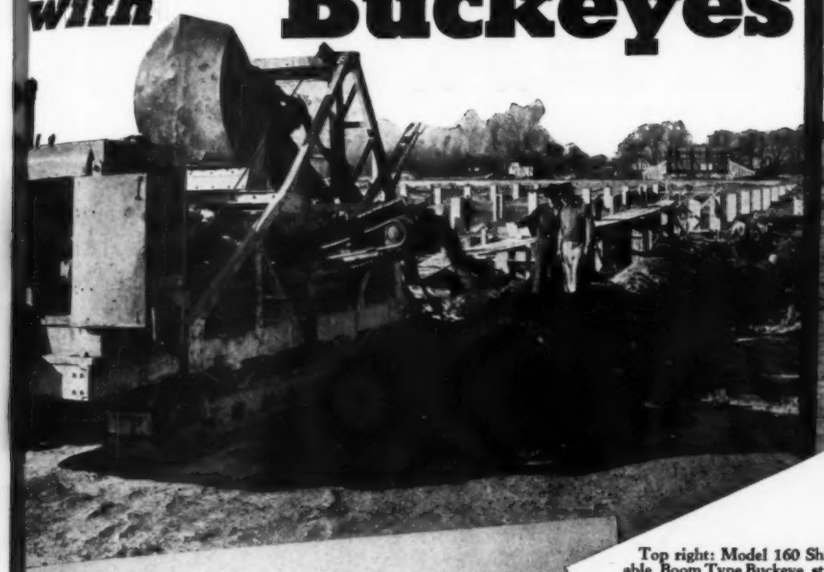
CHAPTER 20. TUNNEL CONSTRUCTION—Detailed descriptions and data on the construction of 27 highway tunnels in the West.

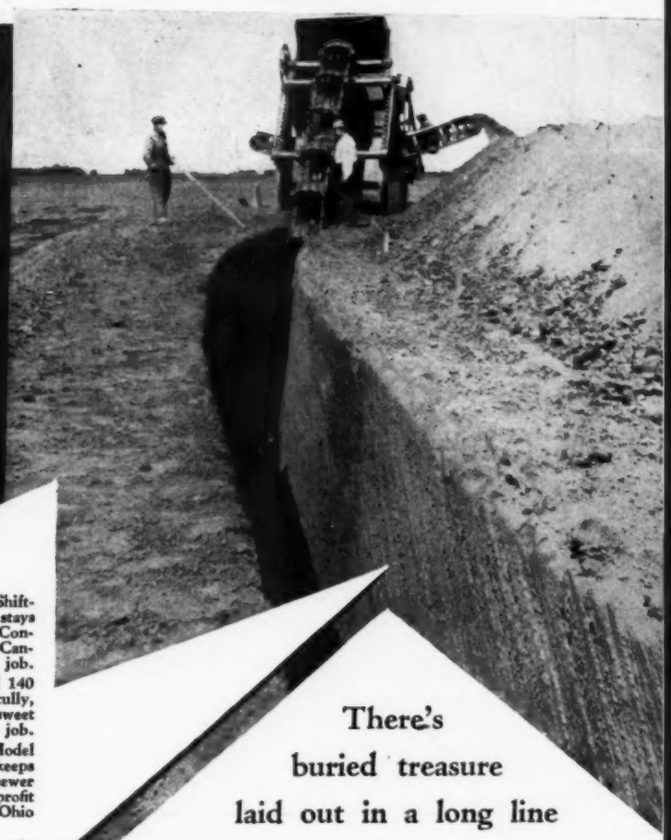
CHAPTER 21. GRASS, SHRUBS AND TREES—Several articles on plantings for landscape improvement and bank protection.

CHAPTER 22. MISCELLANEOUS—Data on pedestrian underpasses, street car loading platforms, truck weighing stations, catch basins and manholes, lignin binder, water pumping, signs and markers, traffic striping, parking meters, highway lighting, radio communication with snow plows, accident prevention, and weather and construction.

INDEX—Unusually complete: arranged for quick reference and maximum convenience.

Stay in the Profit Groove with Buckeyes





Top right: Model 160 Shiftable Boom Type Buckeye stays in the profit groove for Wells Construction Co. on a Calgary, Canada, rush airport drainage job.

Top left: 16 year old Model 140 Buckeye owned by Achille Scully, Contractor, still digs at a sweet profit on a Chicago sewer job.

Below: New, fast, compact Model 410 Boom Type Trencher keeps ahead of schedule on a sewer pipe job, making a nice profit on a low bid for this Ohio contractor.

Center: Compact truck-mounted Wheel Type Model 16-S makes a pay streak for this mid-west contractor on suburban water pipe job.

There's buried treasure laid out in a long line where trenching's to be done and the fastest, surest method to get it out for yourself is with a Buckeye Trencher — it's being done every day. There's a Buckeye for every trenching job—boom and wheel types in sizes and capacities to meet every requirement. Buckeyes are the oldest, broadest and most extensively used line—your guarantee of satisfaction in the machine you buy. Send for new bulletins.

BUCKEYE TRACTION DITCHER COMPANY
FINDLAY, OHIO

See other cost-cutting Buckeye Equipment on Page 57

Built by Buckeye

Convertible Shovels

Trenchers

Tractor Equipment

R-B Finegraders

Road Wideners

Spreaders

FOR EARTHMOVERS WHO WANT

BIG YARDAGES

with Low Equipment Cost . . .

LeTourneau LP Carryalls (15 Heaped Yards) and "Caterpillar" D7 Tractors (80 H. P.)

LP Carryall, pusher loaded, picked up this overflowing load in 48 seconds in a distance of 75 feet.

THE LP Carryall is built for earthmovers who want to move big yardages but don't want to invest in extra big tractors. It has a heaped capacity of 15 yards and is designed for use with the 80 H. P. "Caterpillar" D7 tractor. Very profitable for fleet operation with D7 pusher.

Easy Loading, Narrow Cutting Edge

The LP Carryall has an 8'6" cutting edge, enables you to apply greater drawbar pull per lineal foot of blade. D7 tractor weight and Carryall's narrow overall width greatly facilitate shipping . . . narrow width makes for easier operation in tight places and narrow cuts. High bowl sides and big apron increase bowl capacity and prevent spilling. New arched "A" frame strengthens construction, same time makes for easier unloading. All sheaves and cables operate up out of the dirt, thus give you longer cable life.

See for yourself . . . on your own job . . . how a fleet of job-proved LP Carryalls and D7 tractors can give you big yardages with low equipment investment and low operating costs. Ask your LeTourneau-"Caterpillar" dealer for complete details NOW.

These Profit-Making Yardages Can Be YOURS with LP and D7

Loading on the level with a D7 pusher and hauling over favorable surfaces, you can expect the following results from LP Carryalls and D7 Tractors:

Haul—one way (feet)	Cycle Time (min.)	Trips per 50-min. hour	Pay Yards per 50-min. hour
1000	6.5—7.7	7.7—6.5	92—78
700	5.3—6.1	9.5—8.2	114—99

Variations shown in cycle time, trips per hour and yardage are result of the varying speeds available in D7 tractors. Under same conditions pay yards obtained without a pusher will run approximately 25% less.

LETOURNEAU

PEORIA, ILLINOIS • STOCKTON, CALIFORNIA

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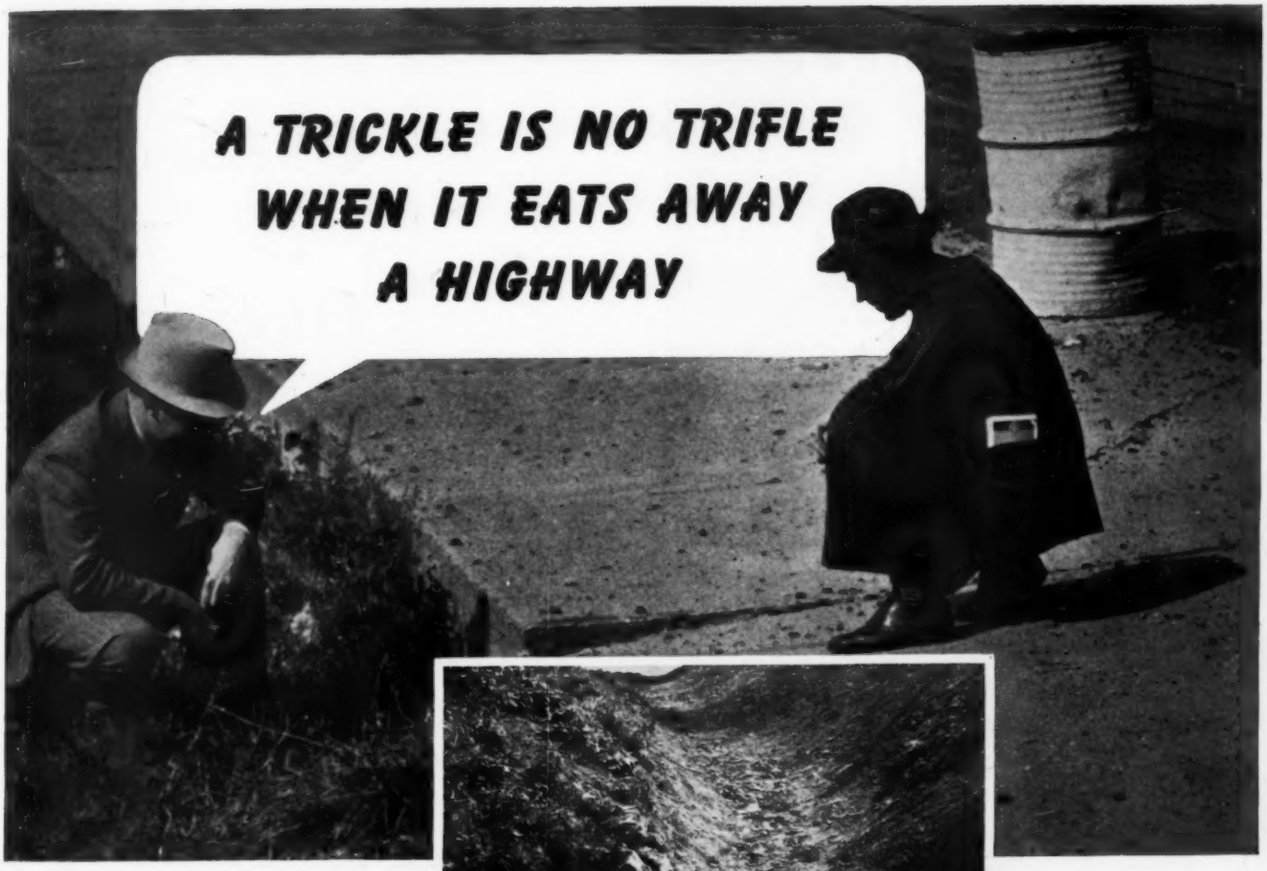
Name Reg. U. S. Pat. Off.



HIGHWAY SLIP costing over $20,000 caused by the failure of a breakable culvert. Corrugated Culverts of U·S·S Galvanized Copper Steel have the strength to withstand extremely heavy loads.

THE CURE. A crow's foot layout of perforated culverts will usually dry up a wet hillside . . . keep water from seeping under the road.

NO highway ever built had enough culverts. Sooner or later some wet spot that may look like a mere trickle cuts loose and eats away the roadbed. Then a costly repair job is necessary.

The problem is to get the most adequate drainage you can for the amount of money available. Here's where corrugated galvanized metal culverts can help you. For long-lasting culverts at low installed cost, U·S·S Galvanized Culvert Sheets are unsurpassed. No expensive forms or foundations are necessary. Ordinary labor can be used for all the grading and filling. The savings made by cheaper labor, faster installation, lower hauling costs enable you to obtain better drainage without spending more money.

U·S·S Galvanized Corrugated Culverts are being used on the nation's most important highways. Long service has been proved over a period of 30 years.

There's a dependable source of supply near you for culverts, sectional plate arches, perforated pipe and other drainage products made of U·S·S Galvanized base metals. We'll gladly furnish you the name of our fabricator in your territory. Save money on your next job by getting a bid from him.

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USS

UNITED STATES STEEL

For National Defense or normal highway needs_use

STANDARD OIL (INDIANA) ASPHALT

here are **3** reasons for using Asphalt

1 It's adaptable
—to every highway paving problem; new construction, resurfacing, widening, or stabilization.

2 It's economical
—because it's easy to lay, with simple equipment, and gives full salvage of existing roadway material.

3 It's time-saving
—because local aggregates, labor, and equipment are readily available.

1 It's adaptable

to every highway paving problem

● Here is an advantage of Asphalt for highway improvement that you should not overlook, whether you are considering defense plans or your regular highway program.

There is a type of construction with Asphalt that exactly suits every paving need. Surfacing unimproved roadways, resurfacing worn existing pavements or widening inadequate roads can be accomplished with the minimum of time and expense by choosing the type of Asphalt construction best suited to each job.

In each type of construction full consideration is given to utilizing existing aggregates or surfacing. That's a big saving to start with. A roadway can be brought to any stage of improvement that the traffic requires. And this road can be further improved from year to year as traffic demands increase without sacrificing the materials already on it.

A Standard Oil Asphalt representative will gladly discuss these and other advantages of Asphalt construction as they might apply to your particular problems and local conditions. Just write Standard Oil (Indiana), 910 South Michigan Avenue, Chicago, for the representative nearest you.

Asphalt for every purpose

STANDARD OIL COMPANY (INDIANA)

ROADS and STREETS

Vol. 84, No. 3 March, 1941

A GILLETTE PUBLICATION

ESTABLISHED 1906

SOIL-CEMENT CONSTRUCTION

OF VILLAGE STREETS, GRANVILLE, NEW YORK

By FRANCIS L. BROWN

Consulting Engineer

THE village of Granville, N. Y., undertook the improvement of several streets a year ago on which the use of a soil-cement base was a subsequent development to the original program. The basic reason for the work was the inability of the existing streets to care for storm drainage and there was an excessive maintenance cost.

The work was laid out to develop residential streets to a section of 27 ft. between 7-in. curbs, with 4-ft. grass plots and 4-ft. sidewalks on both sides. Undertaken in the Fall of 1939 on Irving Avenue, the program was subsequently extended to Morrison Avenue, Maple Street and Rawson Avenue.

Inasmuch as storm drainage was a prime consideration, adequate storm sewers were constructed first. To complete this item several interceptors extending beyond the individual streets have been built, and these will be available for use with other streets in the program as time goes on. Storm sewers of vitrified tile ranging from 12 in. to 36 in. have been used. Catch basins are located at intervals of 300 ft. with minimum street grades of 0.3 per cent. Sewers are designed to carry all storms up to those occurring once in ten years and special care has been taken in the design to prevent overflow at the termini of steep grades when sewers are flowing at capacity.

In the construction of the storm sewers, it was observed that a natural low-grade gravel existed about 4 ft. deep in the construction area. The nearest commercial stone quarry was 20 miles away and it occurred to the writer that substitution for a stone base would be advantageous to the village from a cost standpoint. After some consideration, soil-cement construction was decided upon to utilize the existing material.

Fig. 2.—Spreading the Cement for Mixing with the Soil

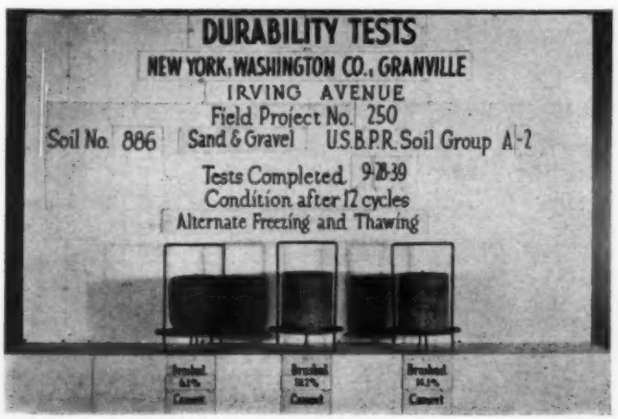


Fig. 1.—Freezing and Thawing Tests Made on the Project Soil

Fig. 3—This Cultivator Was Used to Operate with the Pulverizing Mixer for the Purpose of Keeping the Soil Loose

Fig. 4.—Pulverizing Mixer Was the Rototiller. An Intimate Mixture of Cement and Soil Resulted from Its Operation

Concrete curbs were constructed first, following which the street was scarified and brought to grade. Experience has shown that the loose material should be graded about 1 in. higher than the finished grade to allow for compaction. With 27 ft. width streets, a normal eight-hour run was about 300 ft., although in emergencies with longer hours and good summer weather as high as 700 ft. have been completed.

In dry spells, after grading was completed, the next day's run was scarified and about half of the needed moisture was added the night before. In wet periods, it was often necessary to use the Rototiller (described later) for an hour or two to encourage evaporation of excess moisture. In general the soil showed that for maximum compaction and density 9 per cent of cement by volume and 10 per cent moisture were necessary.

Fig. 5.—About 10 Per Cent of Moisture Was Added and Mixed with the Soil and Cement

Equipment comprised the following:

1. 15-ton roller with hydraulic scarifier
2. 35 HP. crawler tractor
3. Orchard type field cultivator
4. Pressure distributor
5. 5-ft. tractor driven Rototiller
6. Two-drum sheepsfoot roller
7. Motor driven patrol grader.

All of this equipment, except the Rototiller, is standard and has been used for some time. The Rototiller consists of a machine which moves under its own power and which has an attached power driven shaft with spring mounted teeth that may be raised or lowered by a hydraulic unit to engage or disengage the soil over which the machine is travelling. The cutting widths of these units are from 1 to 5 ft. and the cutting assembly is covered by an apron to prevent the earth from flying. It accomplishes the process of plowing, discing and harrowing in one operation.

The approximate moisture content of the scarified soil having been established the day before, a soil test precedes the day's operation to determine the exact requirement. The Rototiller and tractor drawn cultivator begin a pulverizing action and the blades of each are set to operate to a 6 in. depth. After about an hour's operation, the work is leveled off and the cement is distributed. This is done from a previous computation as to the amount required, and bags are spaced accordingly. Each bag is emptied into a pile, then spread evenly with hand rakes.

The next step is the "dry mix." Again the Rototiller and cultivator begin regular trips up and down the day's operation to mix the cement into the soil. The Rototiller is the effective mixer while the cultivator reduces the time of mixing by keeping the material loose and allows the run to be covered more quickly. An hour is plenty of time for this operation.

Fig. 6.—Compaction Was Obtained with a Sheepsfoot Roller Until the Feet of the Roller Refused to Penetrate the Mixture

The "dry mix" is followed by the "wet mix." From the moisture test, the number of gallons of water required for optimum moisture content is easily obtained. Allowance is made for 2 per cent evaporation. An application is made by the distributor, followed by the Rototiller to mix it in. No water is allowed to accumulate in puddles. The distributor makes the necessary number of passes to add the computed gallonage, meanwhile allowing the mixing operation to keep up with it. During all the mixing operation, laborers are kept stationed along the work and they shovel the material which piles up along the curbs out into the mix to secure uniformity.

Fig. 7.—Motorgrader Shaping Was An Important Step

Fig. 8.—Final Finishing Was Done with a Flatwheel Roller

When an even mix is obtained with the required water, the surface is smoothed off with a blade grader and the sheepsfoot roller begins the compaction. As the feet of the roller refuse to penetrate the compacted mix, then, the surface is smoothed out once again by the grader and the smooth roller finishes. Sometimes on dry days a light water application at this point insures the proper bond on the surface. In passing, it may be said that considerable skill is needed of the grade operator and it is on him that the success of the finished grade remains. It may be necessary during blading operations to move small quantities of material by hand shovel from point to point.

Another incidental item is finishing around catch basins and manholes. Prior to mixing, the frames are removed and the openings are covered by steel plates. The material is spread evenly over these plates during the mixing process and compacted. Finally, the material is removed and the plates taken up; the frames are reset and the void between the frame and soil-cement base is filled with 1:3:6 concrete.

Evaporation losses are prevented by a covering of straw or wet burlap on the compacted soil-cement and seven days are allowed for the material to develop strength. Light traffic operations may be carried on over the base the day after construction. Upon removal of the straw, full traffic is allowed to use the road for two weeks to remove scale from the surface. By this time, the base has a ring like concrete and may be sledged without breakage. Compressive strength, as measured by cylinders, is about 1,000 lb. per square inch.

It is usual practice to cover the soil-cement with a wearing surface. In Granville, a prime coat of 1/6 gal. of tar per square yard was used, followed by ½ gallon of hot tar and 40 lbs. of ½ inch stone per yard. A seal coat of ¼ gallon with 15 lbs. of quarter inch stone per yard give the final wearing surface.

The cost of this initial project, using WPA labor, was 77 ct per square yard, with 62 ct chargeable to the soil-cement base and 15 ct to the wearing surface. The cost to the sponsor for the base was 44 ct per square yard.

It is the opinion of the writer that this type of work has a definite place in street construction. Careful laboratory control and care in the selection of materials will mean good results. Caution is advised that all types of soil will not react but tests will reveal this before work needs to be undertaken.

The use of a Rototiller has certain advantages and was conducive to obtaining a thorough mix. This machine was an experimental model rented from Rototiller, Inc., Troy, N. Y., of which C. W. Kelsey is President.

The construction herein described for the village of Granville was directed by the writer as consulting engineer whose representative on the job was Harley J. Morehouse. Representatives of the Portland Cement Association also aided in the execution of the work.

MEASURING TRAFFIC FLOW WITH AUTOMATIC RECORDERS

At the present time automatic traffic recorders are being used in 46 states to obtain continuous records of traffic flow, at more than 500 locations .A comprehensive discussion of the data obtained by means of these recorders is given by L. E. Peabody, Senior Highway Economist, and O. K. Normann, Associate Highway Economist, of the Public Roads Administration, in the January issue of Public Roads. In the preface to their 20 page article the authors state:

Analysis of data from typical stations throughout the United States shows that there was an extremely wide variation in the ratios between traffic for maximum days or hours and the average annual daily traffic, but this variation was considerably less at locations in the southern States as compared with those in northern States. Traffic on the maximum day was normally 233 per cent and the maximum hour 25.4 per cent of the annual average daily traffic. It is uneconomical to design the average highway for a greater hourly volume than the value exceeded during the 30 peak hours each year, and little will be saved in the construction cost and a great deal lost in expediting the movement of traffic if the design will not handle the volume exceeded during the 50 peak hours. However, the variation in traffic flow between locations is such that detailed data are necessary for a complete engineering analysis of the traffic facilities required at any particular location.

Tests of various schedules of operation that are used in highway planning surveys indicate that eighteen 8-hour counts properly scheduled throughout the year produce results within practical limits of accuracy; that the short count schedule by single hours, or shorter periods, is not as accurate, and its use is limited to relatively compact areas such as a city where time loss and cost of travel may be reduced.

A study of the invariance in seasonal and other types of traffic variation over a period of several years provides a measure of the limitations in the use of factors in estimated annual traffic from observations covering but a small period of time, possibly a few hours. The rather remarkable uniformity in such factors provides considerable confidence in the accuracy of the estimates.

As the traffic records accumulate they will permit an analysis of the traffic trends at a large number of points widely distributed throughout the country and should furnish data useful in setting up regional or national business indices. The relatively brief record now available has already proved of value in making estimates of traffic increases on major segments of the highways and streets of the Nation.

World's Largest Airport—The municipal airport of Cleveland, O., with its over 1000 acres of landing area is stated to be the largest airport in the world. It is said that if the three internationally famous airports—Croyden, in England; Le Bourget, in France, and Templehof, in Germany—were placed together in the Cleveland airport, there would be space enough left for another airport as large as any one of them.

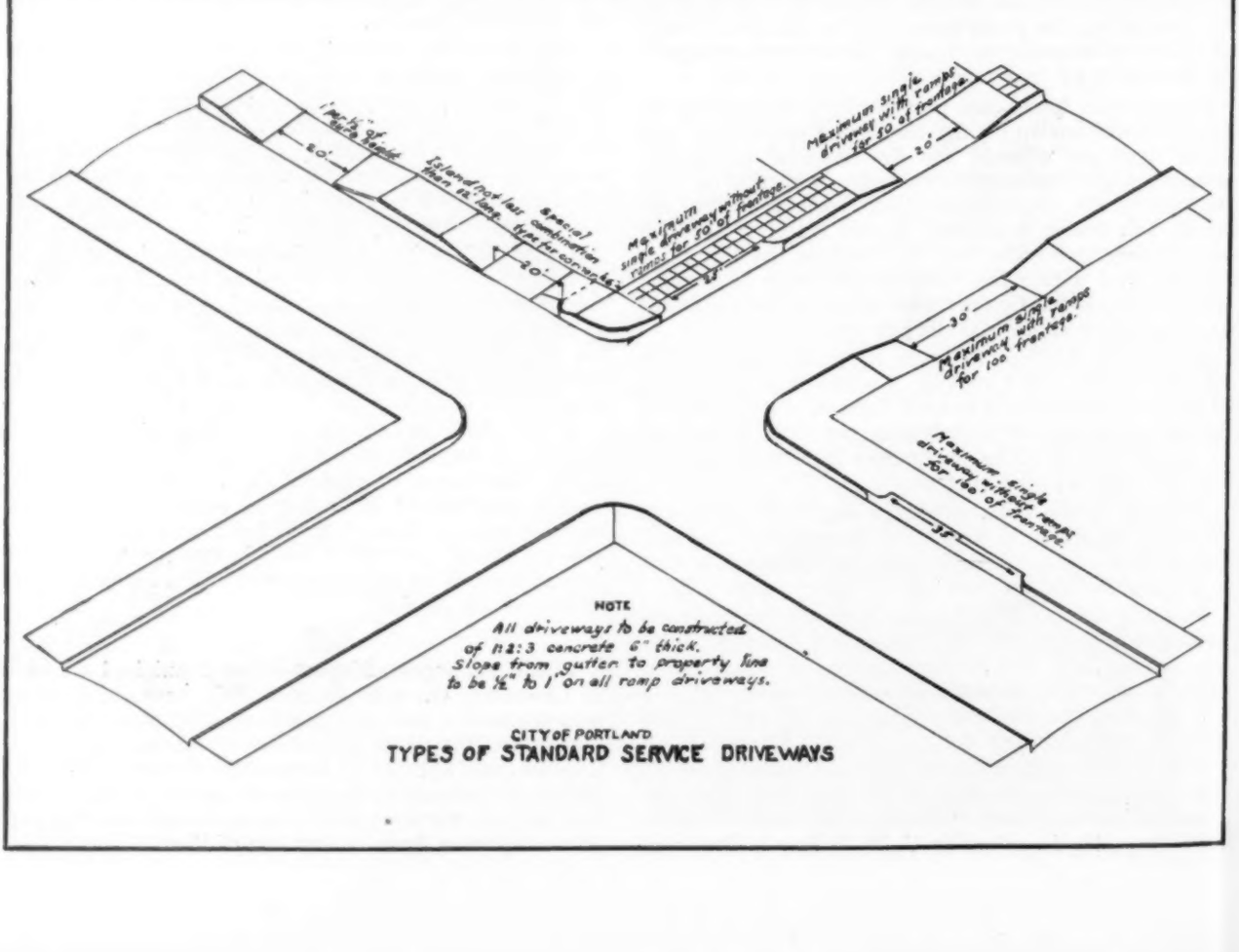
Municipal Regulation of CURB CUTS AND SERVICE DRIVEWAYS

DEVELOPMENT of the "drive-in" service in many types of businesses with the resulting extension of curb cuts and service driveways has made it necessary for many cities to adopt standard regulations for curb and driveway control. The principal considerations in adoption of these regulations have been:

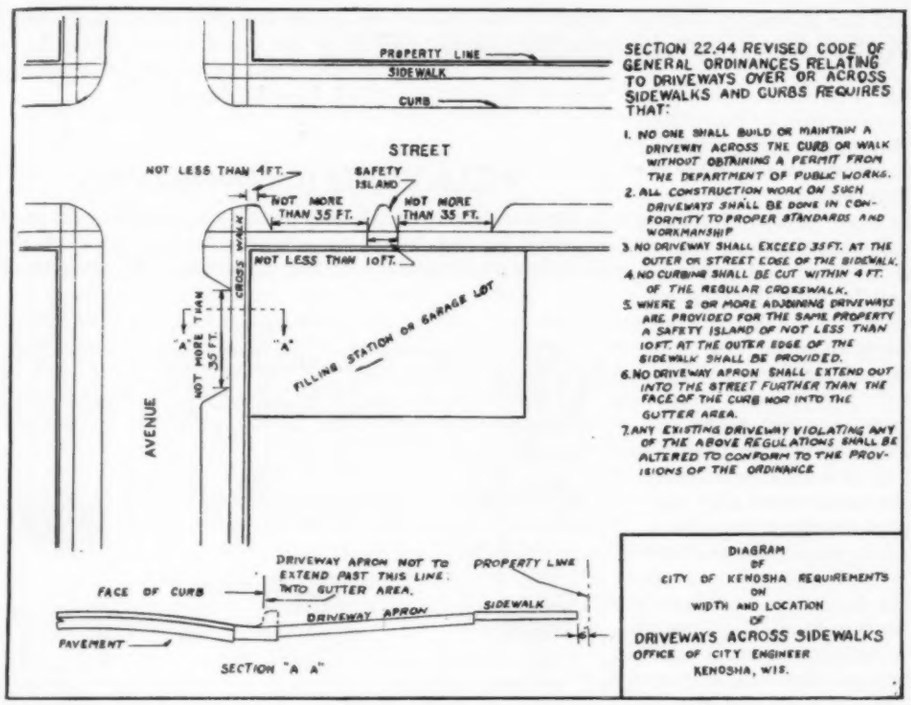
1. *Protection of pedestrians.* Each driveway which crosses a sidewalk creates a hazard for pedestrians. The hazard increases with the width of the driveway.
2. *Conservation of curb parking space.* The parking space in the business district of most cities is limited. Service driveways reduce the amount of potential street parking space available.
3. *Preservation of proper drainage.* To insure proper drainage the city must require a type of construction that will not permit dirt or debris from the street to be thrown upon the apron of the driveway approach by flushers and that will not permit the accumulation or diversion of gutter drainage.
4. *Prevention of sidewalk destruction.* Most sidewalks are reinforced only where original plans provide for service driveways. Construction of driveways at other points results in broken sidewalks unless new sidewalk bases are provided.

It is well established that property owners wishing to construct or maintain service driveways may be subjected to regulations as to driveway width and as to construction specifications. Municipal regulation may not go so far, however, as to deny the property owner ingress to and egress from his property. As far as the authority of the city is concerned, the following general principles obtain:

1. Reasonable provision must be made for access to abutting properties.
2. Reasonable charges may be made by the city for issuing permits and for inspection and paint.
3. Reasonable construction specifications may be enforced.
4. Reasonable regulations may be made governing the remainder of the street front.


Maximum single driveway with ramps for 50' of frontage.
20'
Maximum single driveway without ramps for 50' of frontage.
35'
Special combination type for corners
20'
30'
Maximum single driveway with ramps for 100' frontage.
Maximum single driveway without ramps for 100' of frontage.
35'
NOTE
All driveways to be constructed of 1:2:3 concrete 6" thick. Slope from gutter to property line to be ½" to 1" on all ramp driveways.

CITY OF PORTLAND
TYPES OF STANDARD SERVICE DRIVEWAYS


PROPERTY LINE
SIDEWALK
CURB
STREET
NOT LESS THAN 4FT.
SAFETY ISLAND
NOT MORE THAN 35 FT.
NOT MORE THAN 35 FT.
CROSS WALK
NOT LESS THAN 10FT.
NOT MORE THAN 35 FT.
"A"
"A"
FILLING STATION OR GARAGE LOT
AVENUE
SECTION 22.44 REVISED CODE OF GENERAL ORDINANCES RELATING TO DRIVEWAYS OVER OR ACROSS SIDEWALKS AND CURBS REQUIRES THAT:
1. NO ONE SHALL BUILD OR MAINTAIN A DRIVEWAY ACROSS THE CURB OR WALK WITHOUT OBTAINING A PERMIT FROM THE DEPARTMENT OF PUBLIC WORKS.
2. ALL CONSTRUCTION WORK ON SUCH DRIVEWAYS SHALL BE DONE IN CONFORMITY TO PROPER STANDARDS AND WORKMANSHIP
3. NO DRIVEWAY SHALL EXCEED 35 FT. AT THE OUTER OR STREET EDGE OF THE SIDEWALK.
4. NO CURBING SHALL BE CUT WITHIN 4 FT. OF THE REGULAR CROSSWALK.
5. WHERE 2 OR MORE ADJOINING DRIVEWAYS ARE PROVIDED FOR THE SAME PROPERTY A SAFETY ISLAND OF NOT LESS THAN 10FT. AT THE OUTER EDGE OF THE SIDEWALK SHALL BE PROVIDED.
6. NO DRIVEWAY APRON SHALL EXTEND OUT INTO THE STREET FURTHER THAN THE FACE OF THE CURB NOR INTO THE GUTTER AREA.
7. ANY EXISTING DRIVEWAY VIOLATING ANY OF THE ABOVE REGULATIONS SHALL BE ALTERED TO CONFORM TO THE PROVISIONS OF THE ORDINANCE
DRIVEWAY APRON NOT TO EXTEND PAST THIS LINE INTO GUTTER AREA.
PROPERTY LINE
FACE OF CURB
SIDEWALK
DRIVEWAY APRON
PAVEMENT
SECTION "A A"
DIAGRAM OF CITY OF KENOSHA REQUIREMENTS ON WIDTH AND LOCATION OF DRIVEWAYS ACROSS SIDEWALKS
OFFICE OF CITY ENGINEER
KENOSHA, WIS.

Survey of Existing Driveways

In preparing regulations the city should utilize information as to the width, use, and construction of existing curb cuts and driveways. Any city that has not previously established standards and regulations may secure the necessary information through a survey of existing driveways. NYA and WPA assistance may often be secured for such a survey.

The procedure followed in Kenosha, Wisconsin, in one of the first attempts to analyze the existing practices and the problems involved illustrates the value of such a survey. With the aid of WPA funds the city engineer of Kenosha measured all filling station driveways in the city. At the time of the survey the city had no ordinance controlling curb cuts except the general ordinance requiring a permit to tear up pavement.

The Kenosha survey revealed that all of the service stations in the city had two driveways. A number had three. The larger driveways ranged from 47 feet to 131 feet in width. The second driveways ranged from 30 feet to 82 feet with the exception of one of 13 feet. The driveways of one service station totaled 232 feet, a second 200 feet, a third 198 feet, a fourth 186 feet, a fifth 181 feet, and so on. The average width of all service station driveways was in excess of 50 feet, or a minimum of 100 feet of driveway width for each service station which had two driveways. Analysis of the problem revealed that driveways of 35 feet could reasonably satisfy the needs of the stations. Information was obtained also as to width and existing construction.

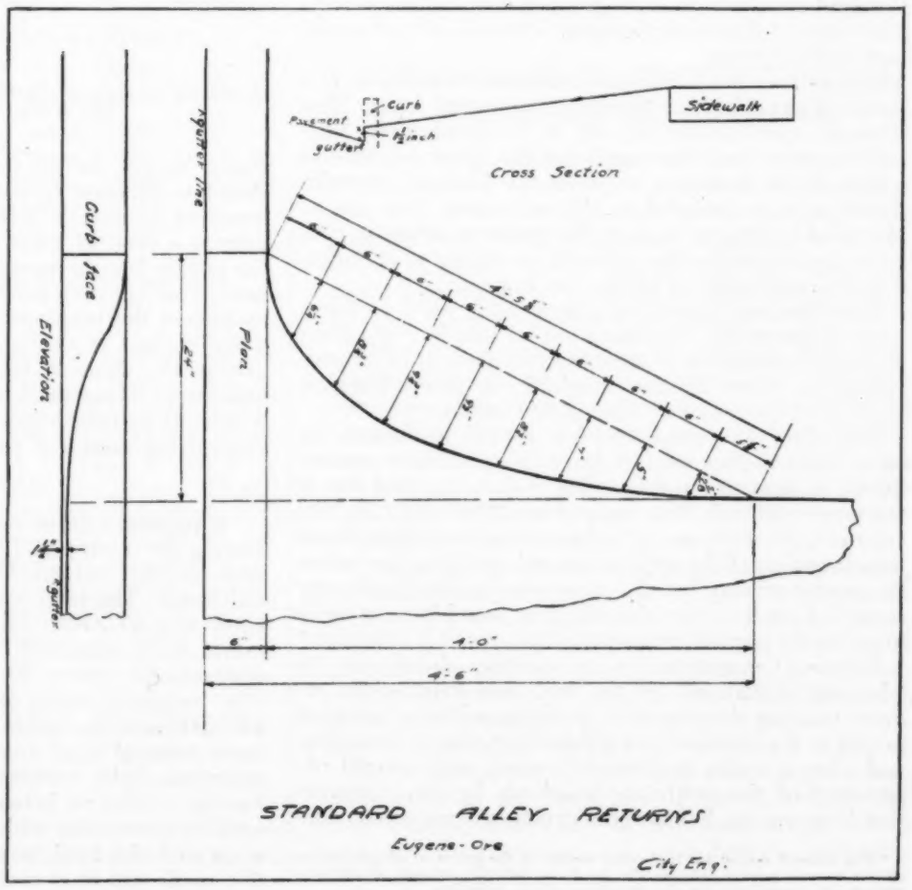
A similar study in Portland, Oregon, revealed unnecessary reservations of space for driveway purposes and resulted in the immediate release of 875 feet for public parking, or space for forty-four additional cars in the most congested section of the city.

Ordinance Provisions

In drafting an ordinance for the control of curb cuts the following provisions should be considered:

Maximum allowable widths of driveways at curb or at the property line. A number of cities vary the permissible driveway widths with the frontage of properties.

In Kenosha all curb cuts are limited to 35 feet in width at the street edge. Eugene, Oregon, limits all curb cuts to 12 feet at the curb edge except where the council allows extra width by special permit. Winnetka, Illinois, gives



the city engineer discretion to set the allowable widths and number of driveways but places a maximum of 16 feet on single driveways.

In a number of cities the same provision applying to single driveways applies to the construction of more than one driveway, except that additional frontage to the amount required for single driveways is required for each additional driveway. The Marshfield, Oregon, ordinance provides that "if more than one service driveway is desired on the same frontage, the maximum length of each driveway shall not exceed 18 feet, and not more than two 18-foot driveways shall be permitted on any given 100 feet frontage" and that ". . . three service driveways not exceeding 14 feet each be permitted, provided . . . not less than 12 feet of straight curb must separate . . . service driveways . . . " Newberg, Oregon, limits driveways to 20 feet where two are to be constructed on the same property and where more than two are proposed limits each to 15 feet in width. In addition, where two or more driveways are constructed they must be separated by 18 feet or more of frontage.

Construction standards for driveways. Proper construction of curb corners and of driveway aprons prevents washing of debris onto the driveway or sidewalk and allows proper drainage. The specifications for such corners are usually established by diagrams made a part of the ordinance and by rulings of the city engineer under the general street and sidewalk construction ordinances of the city. The Eugene, Oregon, specifications call for a curb face of 1½ inches to be retained in order to prevent the washing of debris. The Kenosha, Wisconsin, ordinance specifically indicates that the apron is not to extend beyond the face of the curb and in no case is to extend into the gutter area.

Specification requirements of Kenosha, Eugene, and Portland are set forth in diagrams which follow. A blueprint copy of these specifications is furnished each applicant in these cities.

Reconstruction of sidewalks, whenever necessary, to a standard capable of supporting anticipated loads. New sidewalk specifications should be prepared when sidewalks are to bear increased weight from automotive traffic. Some provision to care for broken sidewalks should also be included in the ordinance. The city of Marshfield, Oregon, requires the property owner to construct and maintain the sidewalk according to specifications to be established by the city engineer.

Miscellaneous regulations governing location of driveways. Requests for driveways are refused by some cities because of proximity to street intersections, fire hydrants, light poles, street lighting standards, or power lines, or because of failure to provide safety islands.

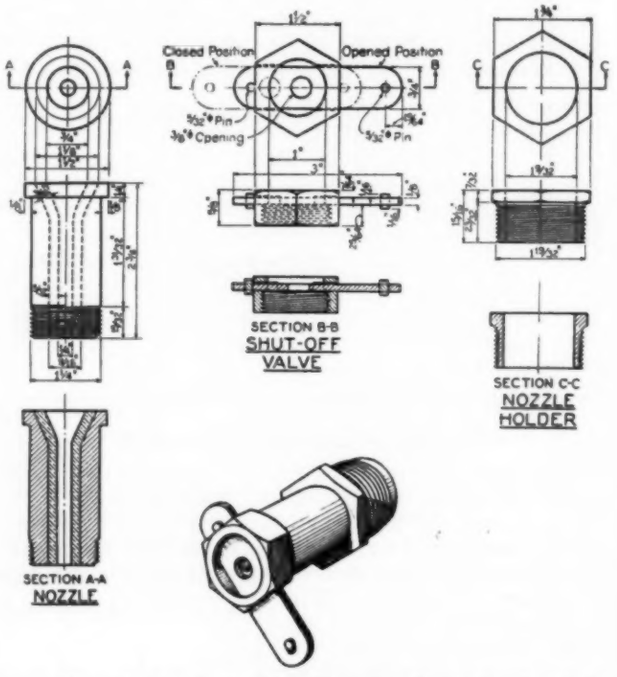
Procedure for administration of the ordinance. In most cities applicants for driveway privileges are required to present an application with a specified fee to the proper official. This varies from $0.50 to $2.00. The engineer, commissioner of public works, or a select board then investigates the application and may grant or refuse the permit or may merely recommend action to the city council. Usually where the officer or board has authority to act on the permit, an appeal to the council is provided.*

Required reconstruction of existing driveways. In adopting regulations for the first time many cities require existing driveways to conform within a specified period to the standards established for new construction, and after a notice to property owners may compel observance of the ordinance standards by city construction if necessary. When reconstruction is necessary, adequate notice should be given the property owner with complete information as to the standards to which he is to conform. A copy of the form of notice used by the city of Kenosha is included in the Appendix.

* The Council review fee may cover review of the action of administrative officers or may merely indicate the fee to be paid for council action on a request for exemption from the provisions of the ordinance.

SPECIAL NOZZLE FOR SANDBLASTING

Special ¼-in. metal core sandblast nozzles are used entirely by the traveling bridge painting crew of the Division of Highways of the California Department of



Assembled Sketch of Shoulder Type Sandblast Nozzle, ¼ in. Orifice

Public Works. In use, the orifice of this nozzle has been found to increase in diameter only 1/32 in. after 100 hours of service. A recent improvement in this equipment is a shut-off valve which is fastened to the end of the nozzle for the purpose of shutting off the flow of sand. This not only saves sand, but permits the operator to inspect the work or move staging without shutting down the pot. It also is advantageous as a safety measure as the shut-off feature eliminates the hazard of undirected flying sand. On all work canvas screens on 8 ft. x 10 ft. frames are used to protect passing vehicles from flying sand and paint.

Equipment Used on California Snow Removal.—During the winter of 1939-40 snow removal operations were carried out on 3281 miles of state highway in California. The total cost of snow removal and control work was $322,800. The equipment used on snow removal work consisted of 185 trucks, 15 tractors, 176 displacement plows, 30 rotary plows, and 41 graders. The inventory value of all snow plows amounted to $551,000 and the inventory value of trucks engaged in snow removal work amounted to $620,700. In addition, numerous light vehicles and miscellaneous equipment, having a value of between $200,000 and $250,000 was used in connection with clearing snow from the highways and the total investment in equipment used for this work was in excess of $1,300,000.

KEEP PERFORMANCE RECORDS

ONE of the findings turned up by an extensive survey of wire rope extending into practically all major industries was the fact that only a very small percentage of industrialists keep performance data or service records on major pieces of equipment—much less so-called "minor" items of material. Not infrequently heavy machines such as gantry cranes, power shovels, car dumpers, scrapers, bulldozers, and the like had no record of maintenance or repair costs behind them; no data sheet for the recording of yardage moved or performance made. And very rarely did the investigators find performance records of "minor" equipment such as wire rope, slings, sheaves, bearings, power transmission equipment, etc. This is a costly error of omission on the part of industrial management. There is, in truth, no such thing as a minor piece of equipment—more especially when such equipment is expendable material. No machine, however large or expensive, is better than the wire rope that operates it. A rope that breaks frequently, thereby throwing into unproductive idleness for hours or days, not only the machine but men as well, is certainly no "minor" piece of equipment. It becomes a major expense—but one which cannot be intelligently corrected without fully detailed information regarding rope type, construction, grade of steel, whether preformed or non-preformed, size of sheaves or drums, condition of treads, character of work, previous performance data, and other pertinent facts.

Wire rope is far more than merely something to reeve onto a machine to make it work. Wire rope is a machine of itself. An ordinary 6x19 rope (six strands of nineteen wires each) is a machine with 114 working, moving parts—every one of which has been drawn to a high degree of mechanical precision. And there is a vast difference in wire ropes. Most ropes may look alike but they aren't. There are many different constructions—each designed for a particular purpose or to fill a specific need. Preformed rope invariably gives longer and better service as a running rope but is ordinarily not needed for guy wires, standing ropes. In some work, such as cable tool drilling in the oil fields, non-preformed ropes have been found superior to preformed; whereas in rotary drilling where the wire lines are merely hoist ropes, preformed has grown in high favor over non-preformed.

Since wire rope isn't just wire rope—and since wire ropes differ pronouncedly in character and service it is only good management to maintain work records of every line installed. Such records kept up-to-date and studied have invariably become the means to more intelligent rope selection which not only means better and longer rope life and reduced rope replacement costs but reduced machine shutdowns and steadier production.

Rope service record forms are not difficult to make. A mimeograph or multilith stencil, readily cut by any typist, will turn out a hundred in short order. The accompanying illustration is a reproduction of such a record form developed by the American Cable Division of the American Chain and Cable Company. It is complete in all essential details and provides space for the record keeping of three lines each of three rope applications.

WIRE ROPE SERVICE RECORD

Equipment ..... MAKE ..... MODEL OR CAPACITY .....

Condition of Sheaves and Drum .....

DESCRIPTION OF WIRE ROPES OR LINES

No. 1 SERVICE ..... LENGTH ..... DIA. ..... CONSTRUCTION ..... GRADE ..... BRAND .....

No. 2 SERVICE ..... LENGTH ..... DIA. ..... CONSTRUCTION ..... GRADE ..... BRAND .....

No. 3 SERVICE ..... LENGTH ..... DIA. ..... CONSTRUCTION ..... GRADE ..... BRAND .....

SERVICE RECORDS OF LINE NO. 1

BRAND ..... DATE INSTALLED ..... REMOVED .....
LUBRICATED (DATES) .....
WORK DONE .....

BRAND ..... DATE INSTALLED ..... REMOVED .....
LUBRICATED (DATES) .....
WORK DONE .....

BRAND ..... DATE INSTALLED ..... REMOVED .....
LUBRICATED (DATES) .....
WORK DONE .....

SERVICE RECORDS OF LINE NO. 2

BRAND ..... DATE INSTALLED ..... REMOVED .....
LUBRICATED (DATES) .....
WORK DONE .....

BRAND ..... DATE INSTALLED ..... REMOVED .....
LUBRICATED (DATES) .....
WORK DONE .....

BRAND ..... DATE INSTALLED ..... REMOVED .....
LUBRICATED (DATES) .....
WORK DONE .....

SERVICE RECORDS OF LINE NO. 3

BRAND ..... DATE INSTALLED ..... REMOVED .....
LUBRICATED (DATES) .....
WORK DONE .....

BRAND ..... DATE INSTALLED ..... REMOVED .....
LUBRICATED (DATES) .....
WORK DONE .....

BRAND ..... DATE INSTALLED ..... REMOVED .....
LUBRICATED (DATES) .....
WORK DONE .....

Wire Rope Service Record, Actual Size of Form is 8 in. Wide by 10 in. High

SUPERINTENDENTS OF CONSTRUCTION NEEDED FOR DEFENSE WORK

An examination has been announced by the U. S. Civil Service Commission to secure superintendents of general construction for work in the national defense program. Broad and responsible experience is required, and qualified persons are urged to file their applications at the Commission's Washington office where they will be rated as received until Dec. 31, 1941.

There are several grades of positions with salaries ranging from $3,200 to $5,600 a year, less a 3½ percent retirement deduction. In general, the duties involve the direction of foremen, laborers, and mechanics on large construction projects. Appointees will inspect materials and workmanship to see that they conform to specifications and will organize men and materials for efficient construction operations.

Competitors must have had progressive experience in the field of general construction. Part of this experience must have been as superintendent on large projects involving excavation, reinforced concrete, steel, wood, and masonry, and supervision of three or more foremen of different building or construction trades. Engineering courses completed at a college or technical institute may be substituted for part of the general experience.

Further information and application forms may be obtained from the Secretary of the Board of U. S. Civil Service Examiners at any first- or second-class post office, or from the U. S. Civil Service Commission, Washington, D. C.

OBSERVATIONS BY THE WAY

By
A. PUDDLE JUMPER

¶ At the recent formal opening ceremonies of the new mid-town tunnel which links Manhattan and Queens, New York City, tunnel authority officials staged a demonstration of the latest fire fighting devices with which the tunnel is equipped. In the photo below, courtesy Walter Kidde & Co., guards are extinguishing an automobile fire with carbon dioxide extinguishers, which smother gasoline and oil flames under clouds of the non-poisonous "soda-pop gas." Because of the danger of panic and traffic tie-ups which would occur in

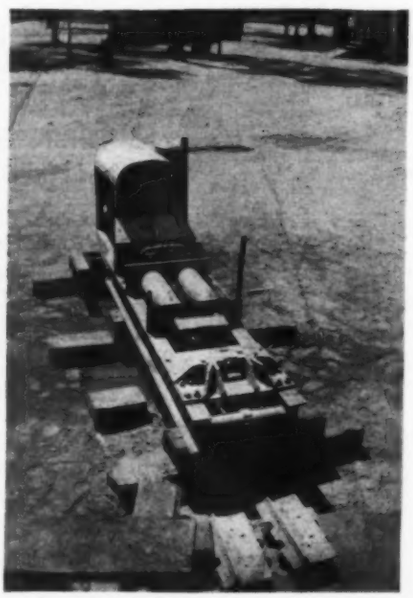
the tunnel in case of a car fire, the tunnel maintenance crew has favored quick acting methods of fire extinguishing which do not involve the use of water or other liquids which might cause skidding when traffic is resumed. The carbon dioxide extinguishers shown in use hold the dry gas under high pressure in steel cylinders, discharging it over the burning surface and smothering the flames without necessity for subsequent clean-up and delay.

• •

¶ Some time ago when spelling bees were quite the rage, there were two young men in Price who had the reputation of being exceptionally good spellers. One of them was the cashier of the bank and the other owned a livery stable. To decide which was the champion their friends arranged a spelling bee. They were running neck and neck and neither had misspelled a word. Finally the word "Auspice" was given and the livery stable man lost.—*Stolen from Wyoming AGC bulletin.*

• •

¶ An interesting tool devised by Mr. C. P. Carawan, R. R. No. 1, Savannah, Ga., is a tractor shoe



straightening outfit. These engineers keep getting new ideas.

• •

¶ Changes in the numbering of West Virginia's primary routes became effective January 1, in an agreement made "by the State Road Commission with adjoining states to make important connecting state routes carry the same number throughout their length. As a result West Virginians starting on these route numbers will be able to continue their journeys into adjoining states without confusion.

• •

¶ Florida has one of the very first highways built in the United States by white men. This is the old Fort San Marco-Fort Caroline Road built by Menendez about 1565. This section of road connecting the city of St. Augustine with St. Johns River is now part of the Spanish Trail—*West Virginia Highways.*

• •

¶ "If we can learn nothing else from Europe," says J. S. Knowlson, President, Stewart-Warner Corpn.—"two lessons are plain:

"First, the peoples who do not hang together, hang separately, and

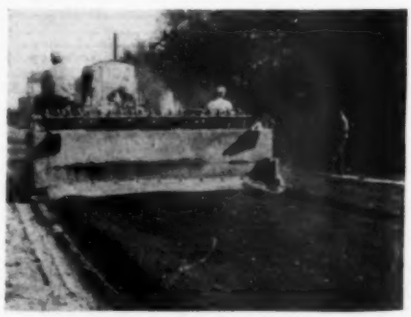
"Second, that factory production is of first importance in preparedness."

• •

¶ "Lips that touch wine shall never touch mine," declared the fair co-ed. And after she graduated she taught school for years and years and years.

• •

¶ Contractor J. C. O'Connor & Sons of Ft. Wayne, Indiana, are stabilizing a soil road with portland cement in Highland County, Ohio,



with a Flynn machine. The outfit was operated slightly over 10 ft. in width so that both lanes could be mixed before spreading and rolling; thus eliminating a center joint.

¶ The general sent for his engineer — an old-fashioned, capable road builder.

"Jim," he asked, "how long will it take to throw a bridge across this river?"

"Three days," the engineer said, after running his fingers through his hair.

"Good," said the general. "Have the draftsman make the drawings right away."

Three days later the general sent for the engineer hardly hoping the bridge could be done so soon.

"How's the bridge?" he asked.

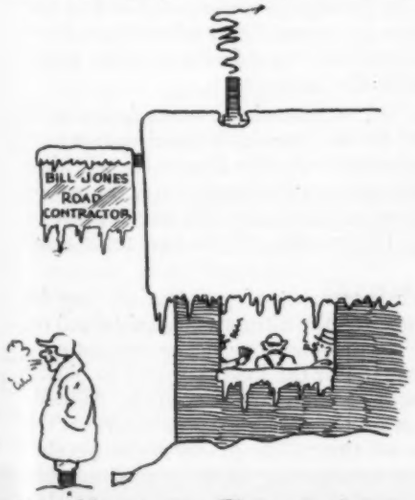
"Bridge is made," was the reply, "and you can march across if you don't have to wait for them pictures. They ain't done yet."—*The Engineerogram.*

• •

¶ Fast way to put in road form pegs. This was taken during the construction of the Pennsylvania Turnpike.

• •

¶ The job office is a cozy place for the crew of Bill Jones, Road Contractor, to play a little poker till the storm blows over. These are happy moments one loves to recall.



¶ To take off black top surface, preparatory to widening U. S. 31 through Spring Hill, Tennessee, and at the same time maintain traffic, presented a tough assignment to Contractors Bell and Bell. They solved it by bringing their regular 6 yd. road-building scraper to the job. In one cycle of operation, the scraper cut along the surface, loaded, hauled and stock piled the material along a side street for later use in resurfacing. Thus, one man and one machine were able to handle the entire construction and keep the highway unobstructed for continuous traffic.

• •

¶ Bill Dale, Assistant Physical Engineer, Oklahoma Materials and Research Laboratory, contributes the following:

A pouring can for handling the heavier blends of asphalt latex joint seal has recently been devised by the Oklahoma state highway laboratory.

To prevent damage from shouldering operations and the penetration of dirt and foreign material into the body of the joint seal, it is necessary that a viscous or stiff blend of asphalt latex joint seal be poured. A blend of this nature is exceedingly difficult to pour with the ordinary pouring cans and without constant inspection the operator in charge of pouring and blending will prepare a more fluid, easier handled mix, than is consistent with good practice.

The enclosed design for a pouring can was worked out with the hope that in removing the objection to handling the heavier blends of joint material, closer cooperation could be obtained from the contractor in blending the heavier material, and such has been the case.

The design for this type of can was built around an ordinary coal hod or bucket. The top of the bucket was covered from the pouring lip to a point about four inches from the back. A rectangular opening 1 in. in width and 2 in. in length, in the center of, and extending down from the pouring lip was made. Two flexible metal fins, 2 in. in height by 4 in. in width, were then attached parallel to, and one-half inch from each side of the opening. The fins extended 1 in. beyond each end of the opening.

A neat joint of any width between 3/16 in. to 2 in. may be poured without a windbreak with this can. The cans have a capacity in excess of two gallons and can be emptied in from ½ to 1½ minutes.

It is probable that this type of bucket would be successful in handling any type of hot or cold poured joint material possessing a high viscosity at the time of pouring.

• •

¶ Mrs. Black: Does your husband have a den?

Mrs. White: No. He growls all over the house.

• •

¶ The cost of operating Minnesota's Highway Department fleet of "blizzard busters" comprising more than 500 motorized snow fighting units is approximately $2,600 per hour.—*Minnesota Highway News.*

• •

¶ Herewith picture of the little man who wasn't there. He's wearing rimless spectacles of invisible glass and reading between the lines of the unwritten law.

• •

¶ We admire the woman who wants to hold on to her youth, but not while he's driving the car.—*Montana Center Line.*

Correlation of

PLASTICITY INDEX AND LIQUID LIMIT WITH STABILITY

By L. A. DEKLOTZ
Portland, Oregon

MOST specifications for ballast, base and top course materials in highway construction today contain requirements that the liquid limit and plasticity index shall not exceed certain values. The desirability and effectiveness of these requirements are well established, but have not been expressed or related quantatively to the function which soils and aggregate mixtures perform in highways, i.e., supporting loads.

Consideration of the load supporting ability of a soil or an aggregate mixture indicates that it is affected by both the quantity and the quality of the soil portion. The investigation described herewith was accordingly undertaken to study the problem. In general, the method employed consisted of determining the change in stability of several specimens as either the quantity of soil or the liquid limit and plasticity index changed. The specimens consisted of coarse material and soil. Coarse material was that portion retained on a No. 40 sieve. The soil portion of a specimen consisted of the material passing the No. 40 sieve. The stability of each specimen was determined by means of the bearing value test originated by the California Department of Public Works, Division of Highways.

A clay and a sandy loam were mixed in various proportions and the liquid limits and plasticity indices of the mixtures determined. A sieve analysis of each soil was made. After these tests had been completed, three soils were selected, the best being one which just met the usual specification requirements. These soils were designated A, B and C. Their liquid limits and plasticity indices were as follows:

	LL	PI
Soil A	25.4	4.1
Soil B	33.0	13.5
Soil C	44.0	21.2

Aggregate Used Was Rounded Gravel Particles Graded According to Sample No. 0 in Table I

Rounded gravel was selected for the coarse material in order to eliminate the effect of mechanical interlocking of particles. It was washed and separated into sizes retained on the ¾ in., ½ in., ⅜ in., ¼ in., No. 4, No. 10, and No. 40 sieves, and recombined to make ten coarse material specimens. (The grading is shown as No. 0 in Table I.) This grading was selected because when 13 per cent of soil was added, a specimen having a maximum density grading was obtained.

TABLE I
MECHANICAL ANALYSIS OF SPECIMEN MIXTURES

Sample No. / Percent Passing	0	1-A	1-B	1-C	2-A	2-B	2-C	3-A	3-B	3-C
1 in.	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
¾ in.	85.0	87.0	87.0	87.0	88.3	88.3	88.3	90.0	90.0	90.0
½ in.	66.6	71.0	71.0	71.0	74.3	74.3	74.3	77.7	77.7	77.7
⅜ in.	55.1	61.0	61.0	61.0	65.4	65.4	65.4	70.0	70.0	70.0
¼ in.	42.4	50.0	50.0	50.0	55.8	55.8	55.8	61.4	61.4	61.4
No. 4	34.5	43.0	43.0	43.0	49.5	49.5	49.5	56.2	56.2	56.2
No. 10	18.4	29.0	29.0	29.0	37.2	37.2	37.2	45.3	45.3	45.3
No. 40	0	13.0	13.0	13.0	23.0	23.0	23.0	33.1	33.1	33.1
No. 65	0	10.9	11.9	12.9	19.3	21.0	22.8	27.7	30.3	32.8
No. 150	0	5.6	8.8	12.0	9.9	15.5	21.2	14.2	22.4	30.4
No. 200	0	4.6	8.1	11.6	8.2	14.4	20.6	11.8	20.6	29.5

Then 13 per cent of soils A, B and C were added to each of three specimens of coarse material and designated as specimens No. 1-A, 1-B and 1-C respectively. In like manner 23 per cent and 33 per cent of soils A, B and C were added to specimens of coarse material and the resulting specimens designated 2-A, 2-B, 2-C, 3-A, 3-B and 3-C. Specimens having the same number had the same grading and same per cent of soil while those having the same letter contained the same soil. The gradings are shown graphically in figure 1.

The bearing value test was made in accordance with the method described in the Standard Specifications of the California Department of Public Works, except that after completion of the test on the upper face, the specimen was reversed, reconsolidated, and the test duplicated on the opposite end. The results of the two tests were averaged.

The loads for each increment of penetration may be expressed as percentages of the ultimate load obtained on a standard specimen, or, the load for each increment may be expressed in percentage of the load required to obtain the same penetration on a standard specimen. Accordingly, it appeared that an aggregate may be rated on the basis of the average of the ratios of its bearing value for each increment of penetration to the corresponding standard value. The use of this average ratio was believed to be desirable as a basis for comparison as some

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5. Crowd clutch, extra wide to deliver full digging power, mounted on roller bearings; two-piece, easily reversed bands.

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3. Steers either direction.
4. Travel and safety lock.
5. Mechanism runs in oil bath
6. Generous underneath clearances.
7. Centralized lubrication.
8. Wider treads.

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3. Door stop to protect stick.
4. Automatic power dipper trip.
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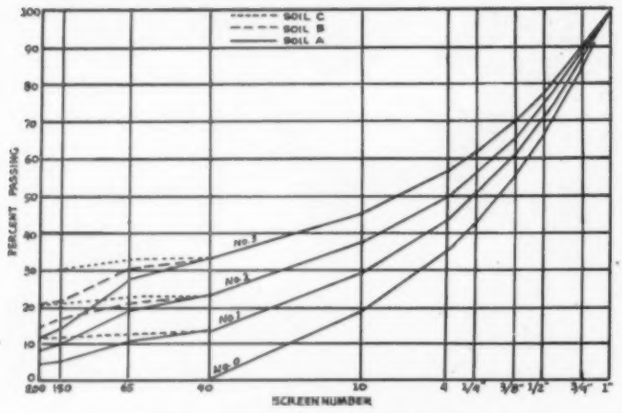


Fig. 1.—Grading of Specimens

variation in individual ratios was observed to occur when the piston encountered large particles of the aggregate.

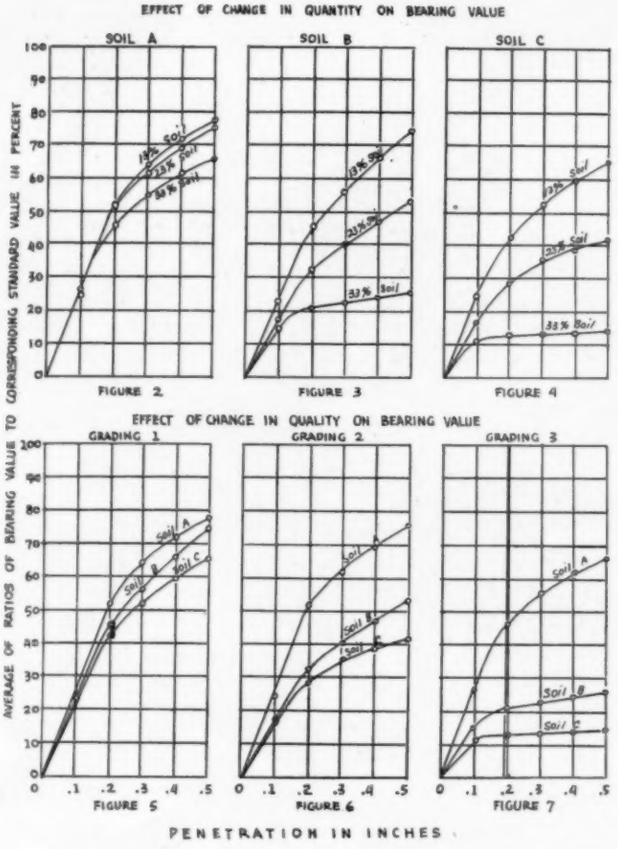
The average per cent of ultimate standard bearing value was plotted against penetration for two arrangements of the test data each consisting of three sets of curves.

In the first group, figures 2, 3, and 4, the effect of change in the quantity is indicated, the same soil being represented by the three curves in each particular set.

Figure 2 indicates that changing the per cent of the "A" soil from 13 per cent to 33 per cent has a relatively small effect on the bearing value. The bearing values shown in figure 3, indicate that variation of the quantity of the less desirable "B" soil has a definite effect, while reference to figure 4 shows that variation in the per cent of the clay-like "C" soil results in a serious decrease in the bearing value.

In the second group, figures 5, 6, and 7, the effect of change in the quality of the soil is indicated, the grading of the aggregate or the per cent of soil represented by the three curves in each particular set being the same.

Figure 5, representing the maximum density grading set, indicates that change in the quality of soil from $PI = 4.1$ and $LL = 25.4$ to $PI = 21.2$ and $LL = 44.0$ has relatively little effect on the bearing value. This is probably due to the fact that in this grading most of the



load is transferred directly from grain to grain of the larger material while the soil merely fills the voids.

Figure 6, representing gradings containing 23 per cent of soil, indicates some decrease in bearing value as the quality of the soil changes, and figure 7, representing gradings containing 33 per cent of soil, shows a considerable decrease as the quality changes.

Plotting percentage of soil against the average of the ratios of the bearing value for each increment of penetration to the corresponding standard values for each specimen, three curves were obtained, figure 8, which

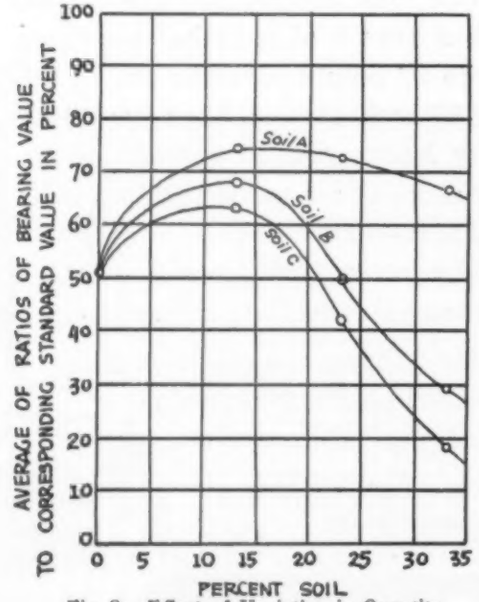


Fig. 8.—Effect of Variation in Quantity

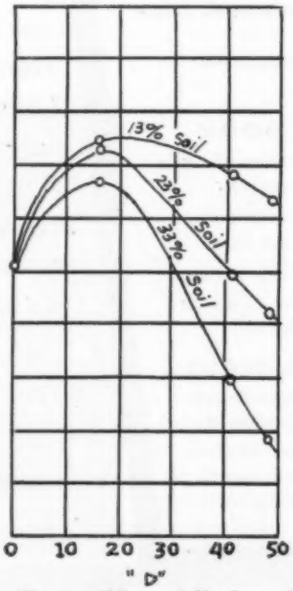


Fig. 9.—Effect of Variation in "D"

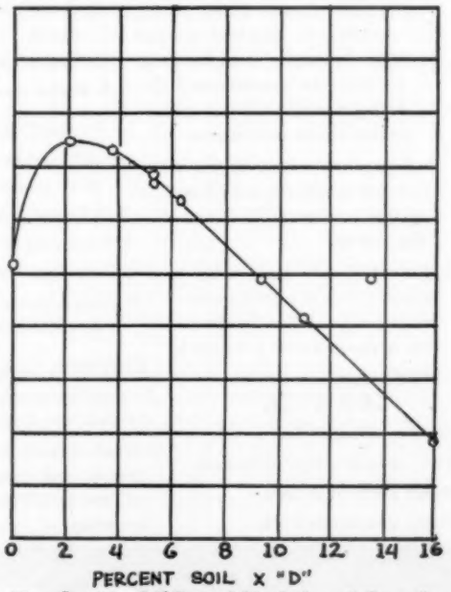


Fig. 10.—Combined Effect of Variation of Quantity and "D"

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Profitable finishing calls for planning, organization ... and the right equipment. Road-builders find it pays to let 2-wheel scrapers work ahead of graders and hand labor. They take care of all odds and ends in a hurry. Cut high spots ... fill-in low places ... rear-dump around culverts, bridge abutments, other close places ... build up driveways and approaches ... make special ditches ... handle all kinds of miscellaneous work. Sailing along, close behind ... your Leaning Frame grader gives the final necessary touches. Slopes will be smooth and uniform because the operator can't go wrong —needs only to keep a level platform ... it's his gauge. There will be little left for hand-finishers. Plug *your* end-of-the-job leaks! Try this cost cutting finishing method. Let your Allis-Chalmers dealer prove how profitable it can be for you. See him ... NOW!

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Digs and loads solid dirt, clay, gravel at the rate of 30 to 40 yards an hour ... 40 to 50 yards from stockpile. Use it in the cut or borrow pit ... load aggregate. Cuts labor cost preparing rip rap beds, digging special ditches, excavating for culverts, for removal of old pipe or for placing new pipe, removing dirt around culvert headwalls, bridge wings and abutments. Just the thing for cleaning out surplus material between forms for fine grading on concrete work. No end to its uses!

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TRACTOR DIVISION – MILWAUKEE, U.S.A. TRACTORS ENGINES ROAD MACHINERY

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meet at the average ratio determined for specimen No. 0. These curves illustrate the effect of variation in the quantity of soil.

Figure 8 also indicates the desirability of the generally used limitations of the liquid limit and plasticity index, namely 25 and 6. The bearing value of aggregates containing soil A, which conforms closely to these requirements, is noted to decrease much less rapidly as the quantity percentage increases than those containing other soils.

Empirical Soil Factor Suggested

The relationship between stability and quality could be partially indicated by using either the liquid limit or the plasticity index as a measure of quality. However, as both liquid limit and plasticity index are indicative of the quality of soils, it seemed desirable to combine them as the quantity, $100 - \frac{PI}{LL}$. For convenience this quantity is hereafter referred to as *"D"*. As far as is known this number has no physical significance, but as will appear later, it seems to be a particularly convenient reference value for the comparison of various soils.

Plotting *"D"* against the average of the ratios of the bearing value for each increment of penetration to the corresponding standard value for each specimen resulted in three curves, figure 9, which the somewhat similar to those in figure 8, indicating the effect of variation in quality. The value plotted for *"D"* = O was obtained from the test of Specimen No. 0 which contained no material passing a No. 40 sieve.

From a review of the results obtained up to this point, it appeared that the influence of the soil in a given specimen on its bearing value would be proportional to *"D"* as well as to the quantity of soil, or if the product of the per cent of soil and the *"D"* value for each specimen were plotted against their respective bearing values that all the points would fall on one curve.

Figure 10 shows the curve which resulted. The points, it will be observed, fall so as to locate a curve very definitely. From this curve it is apparent that the stability for all practical purposes varies directly as the per cent of soil and the *"D"* for values of the quantity *"per cent Soil* $\times$ *D"* from 2 to 16. Also that for values of *"per cent Soil* $\times$ *D"* greater than 2, the aggregate having the larger *"per cent Soil* $\times$ *D"* will have the lesser stability.

Conclusions

As a result of this series of tests it was found that there appears to be a definite relationship between the plasticity index and liquid limit and stability which should be of considerable value in the design of base and surface courses. That is, after accumulating an adequate background of stability, plastic limit and liquid tests, it appears that bearing values could be predicted on the basis of the quantity *"D"* as determined by simple laboratory tests.

This article is based on a report, presented at the recent meeting of the Highway Research Board, covering an investigation made by the writer at Oregon State College, School of Engineering.

▼

50 Miles Paving for Airport—In a paper presented at the last convention of The Asphalt Institute, Edward A. Willis, Associate Highway Engineer, Public Roads Administration, stated that the modern Class 4 airport has an area of paved runways and taxiways equivalent to some 50 to 75 miles of highway 20 ft. wide.

PERSONNEL EMPLOYED IN SOILS WORK

The importance of highway soils investigation and construction was clearly brought out in a report presented at the recent 20th annual meeting of the Highway Research by Levi Muir, Materials Engineer, Utah State Roads Commission. The report was based on a questionnaire sent to state highway departments asking the number of men employed on soils work.

The replies show that nearly all highway departments have fully equipped soils laboratories operating at this time. Twenty-five states report one or more laboratory soil chiefs working full time. The other states reporting have soils chiefs devoting part time to this work. A total of 58 laboratory chiefs are employed full time and 11 devote part of their time to this work. Two hundred twenty-nine soil technicians work full time and 34 part time in headquarters laboratories. A small number of laborers are employed and some states report preparing the soils profiles at the laboratory.

Three hundred ninety one soils chiefs are employed directing field investigation work. In addition, 25 men are employed part time in this phase of the soils work.

Ninety soils technicians are employed full time and 85 part time in investigation work. In addition, 151 laborers were required at least part time on investigations.

Most states were rather definite as to the number of men engaged in laboratory and field investigation work, but were forced to estimate the personnel connected with construction. In general each project was supplied a field laboratory man, and in addition a grading inspector for each shift.

On the basis of 300 working days per year for a full time employee and 150 days for a part time man, the returns from this survey show a total of more than 600,000 man days employed in all phases of soils work.

▼

J. E. PENNYBACKER DIES

J. E. Pennybacker, Managing Director, The Asphalt Institute, New York, N. Y., died Feb. 25 at Delray Beach, Fla. He is survived by his wife and daughter, Miss Caroline Louise and two sisters, Miss Caroline M. Pennybacker and Mrs. Francis Pennybacker Lockwood (all of White Plains, N. Y.).

J. E. Pennybacker

Mr. Pennybacker was born Jan. 1, 1878 in Franklin, W. Va. He was educated at the University of West Virginia and Georgetown University, receiving the degree of L.L.B. from the latter. He was Chief of Economics, U. S. Bureau of Public Roads, 1906-10; Secretary, American Highway Association, 1910-14; Statistician, U. S. Senate Committee on Post Offices and Post Roads, 1912; Adviser, Ontario Highway Commission, 1913; Chief of Management, U. S. Bureau of Public Roads, 1914-17. Secretary, U. S. Highways Council (War body), 1917-18. Chairman Road Board American Automobile Association, 1919. He had been managing director of The Asphalt Institute since 1919.

Mr. Pennybacker was a founder of the American Association of State Highway Officials, and a framer of the first Federal Aid highway legislation. He was a director of the American Road Builders Association.

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LEADERS IN DRILLING EQUIPMENT

PATCHING SPALLED AREAS WITH CEMENT MORTAR

Courtesy H. F. CLEMMER
Engineer of Materials, Department of Highways, District of Columbia

EXCELLENT success has been obtained by the Department of Highways of the District of Columbia, in patching shallow spalled areas in concrete pavements with cement mortar, using a 1:2 mix with a very low water content and calcium chloride as an accelerator. A little coloring material was also used in the mortar, either yellow ocher or carbon emulsion, depending on color of surrounding surface. The area to be patched was first trimmed and cleaned with muriatic or a similar acid and washed with water, then brushed with mortar before a full application of the same material was made. The areas were opened to traffic at the end of the same day on which mortar was placed. The depth of patch averaged 2 in., although a number were under this dimension. Engineers of the Public Roads Administration inspected some patches that were in place three or four years and report a neat appearance and no signs of failure.

A survey of the repairs on all pavements made by the District of Columbia shows that approximately 80 percent of the repairs remained in place, the oldest being six years. The average cost of repairing the spalled areas is estimated at approximately $2 per patch.

The disintegrated area is trimmed the day before actual patching operations. The depression is then covered with earth or canvas, if sufficiently shallow, to avoid the use of a traffic barricade over night. Actual patching starts in the morning so that repaired section can be opened to traffic by the end of the working day. Unskilled labor is said to be competent to handle this work. Four men comprise a crew.

An approximately 25 percent solution of muriatic or similar acid is poured over the area. The acid is then washed out and the surface is ready for patching. It will be noted that in places the depth measures much less than 2 in.

The coat of mortar is brushed over the surface to insure a good bond. The entire depression is then filled with same material including a little coloring.

The patch is then brushed to match surface finish and is covered and barricaded for remainder of the day, but is opened to evening traffic.

Procedure in Pictures

Left to Right

Chipping Out Unsound Material

Spalled Area Properly Cleaned

Pouring Dilute Solution of Acid

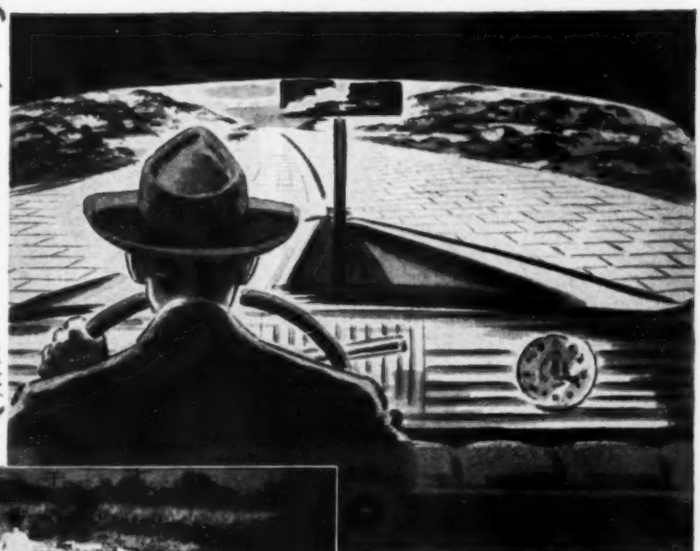
Brushing Surface to Thoroughly Clean Concrete

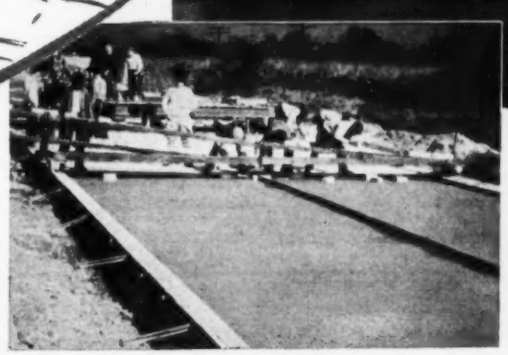
Washing With Water

Area Properly Cleaned and Ready for Repair

for Smooth rides ...

BUILD A MODERN BRICK PAVEMENT





Not to be confused with standard two-course construction is this new and approved method for highway surfaces. You can now build brick roads with a perfect traffic surface at substantially lower cost! It is called vibrated monolithic brick... Vibrating machinery, recently developed, makes this possible.

In this method of construction (cut shows job under way in Jefferson County, Ohio) the brick are vibrated into the freshly placed concrete. Expansion and control joints are used. Grout filler completes the job.

FOR truck or car, modern brick pavements are popular with the traffic. They give comfort to the highest degree — a superlatively smooth, even traffic surface — an ease of driving that makes them favorite routes.

Unless you've followed brick construction very closely, you may have overlooked important new developments. For example, Vibrated Monolithic brick construction which is illustrated above.

And then there are many new advances in the traditional two-course brick pavement such as wire-cut, non-skid surface, rolling on boards; surface filler removal; mastic bedding courses. All these are potent factors in ever-smooth modern brick pavement surfaces.

Hundreds of modern brick pavements have been built in the past few years. They are headed towards 50 years of trouble-free service. Like their predecessors, many of them will reach that anniversary — perhaps pass it! For of all commonly used paving materials, Vitrified Brick has by far the greatest resistance to weather damage — the starting point of most pavement failures.

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Brushing Surface With Thin Coat of Cement Paste

Trowelling Mortar

Finishing Surface

Finishing Edges of Patch

Brushing Patch to Match Surface Finish

Covering the Patch

METHOD FOR DETERMINING BEARING CAPACITY OF SOIL

A method for obtaining the bearing capacity of the road structure on any of its individual components was described by Fred Burggraf, Research Engineer, Highway Research Board, in his paper presented at the recent 20th annual meeting of the Highway Research Board.

This method utilizes the anchorage obtained by placing an auger in the soil to a suitable depth. A simple beam arrangement, which engages a yoke at the upper end of the auger system, and against which the shear machine hydraulic jack operates, produces a force necessary for determining the bearing capacity of the soil. This method precludes the use of loaded trucks or other vehicles as a medium for obtaining the necessary loading capacity. It was especially designed to measure the observed "softening action" of stabilized bases under thin bituminous mats during the "spring break-up" period, but it can also be utilized for determining the bearing capacity of the subgrade or other road structure components.

BANDING PILE BUTTS FOR HEAVY DRIVING

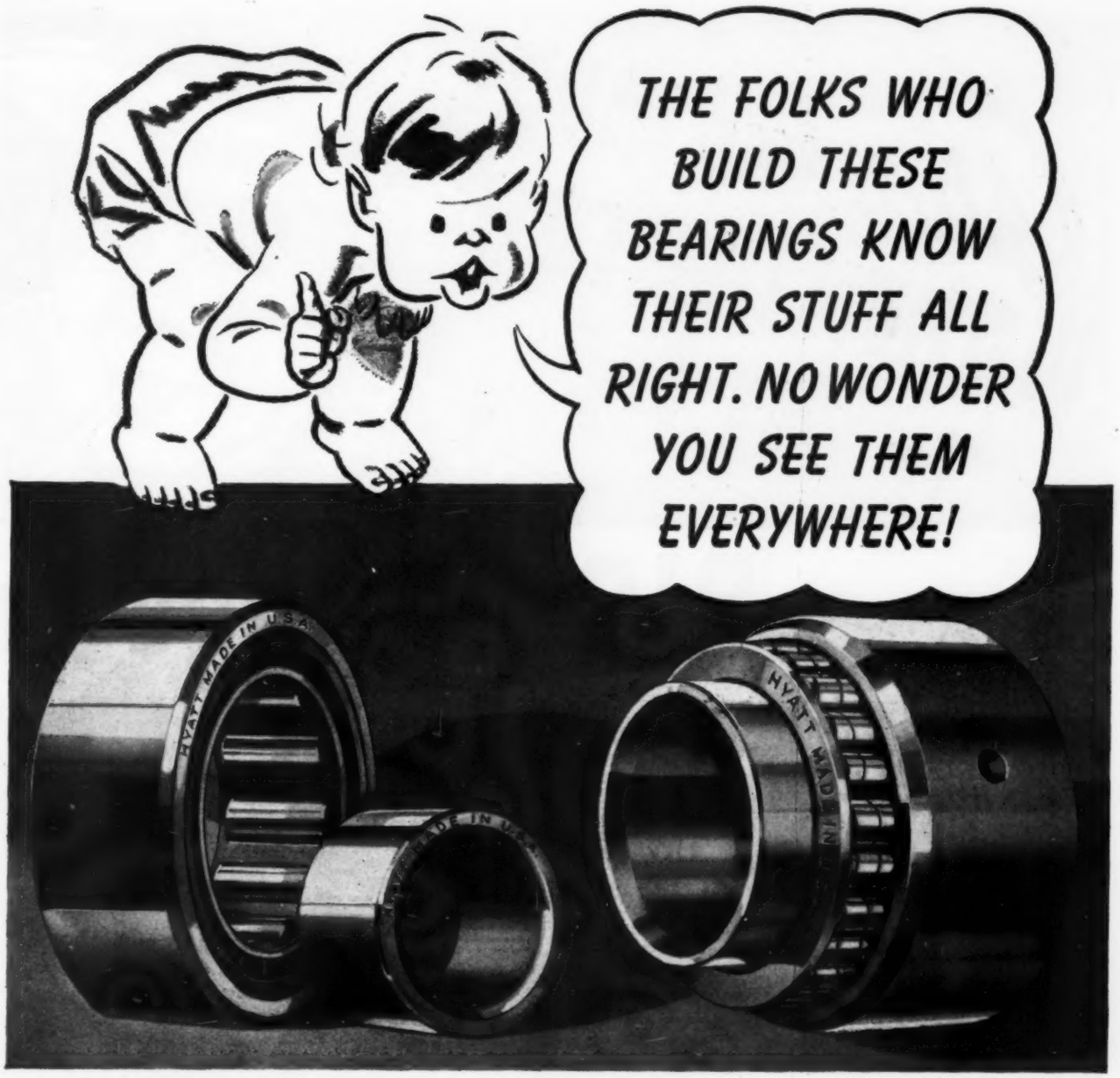
Banding of pile butts has been found of assistance in cases of hard driving. If done properly it tends to reinforce or strengthen the butt of the pile against the impact of heavy, continued blows of the hammer. According to *Wood Preserving News*, where banding is deemed desirable, the Atchison, Topeka and Santa Fe Ry. has adopted the practice of wrapping the butt of the pile with No. 12 gage wire for a width of 4 in. This band is placed on the pile butt just below the portion commonly covered by the follower block. The wire is wound tightly around the pile and stapled in place. The usual procedure followed by the company is to band the piles at the treating plant just before they are placed in the pressure retorts for treatment. Immediately after completion of the treating process, the piles are shipped to the bridge site for driving.

PAVEMENT MARKINGS PLACED WITH SPRAY GUN

The California Division of Highways places pavement markings, such as stop lines, school and railroad crossing markings, etc., with spray guns. It has found this method considerably faster and more economical than the old plan of placing by hand brushing.

Roadside Plantings in Indiana.—Since the roadside improvement program was inaugurated by the State Highway Commission in 1934, approximately 100,000 trees and more than 2,000,000 shrubs and vines have been used in roadside plantings. Roadside improvement work has been completed along 1,250 miles of state highways and a continuation of this program is planned.

Michigan Spent $106,000,000 in 7 Years on Road Construction.—During the 7 years ending June 30, 1940, a little more than $106,000,000 has been encumbered by construction contracts of the Michigan State Highway Department or expended through the Works Progress Administration in carrying out road construction. The projects involved 3,879 miles of highway, 172 highway bridges, and 76 grade separations as well as other auxiliary construction such as dock improvements at the Straits of Mackinac.


THE FOLKS WHO BUILD THESE BEARINGS KNOW THEIR STUFF ALL RIGHT. NO WONDER YOU SEE THEM EVERYWHERE!
HYATT MADE IN U.S.A.
HYATT MADE IN

KEEP THEM YOUNG WITH HYATTS

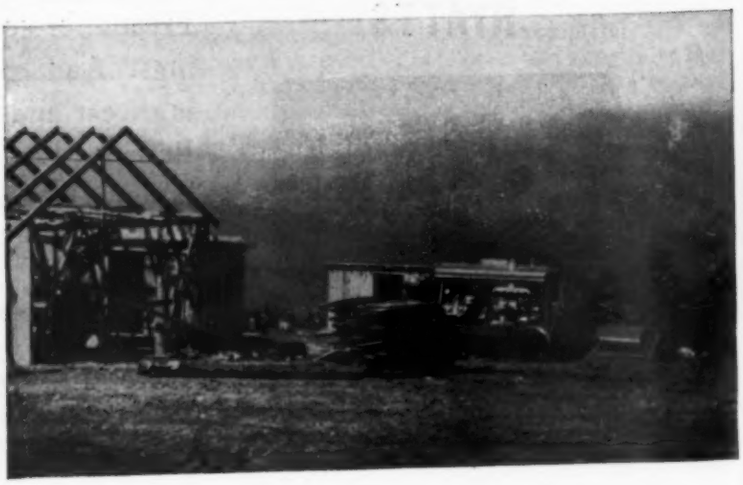
Right you are, Rollo! Because those who build Hyatts into machines they manufacture, or specify Hyatts for equipment they buy, know their bearings. And know that the best way to keep bearing wear and care *out* is to put Hyatts *in!* Hyatt Bearings Division, General Motors Sales Corporation, Harrison, N. J., Chicago, Pittsburgh, Detroit and San Francisco.

HYATT

ROLLER BEARINGS

QUIET

BIG Savings on



Every contractor wants to keep his costs down. That's how he gets the job... and that's how he makes a profit on it. An ever-increasing number of contractors are saying "Give me MORE WORTHINGTON IN '41"... they know Worthington Equipment will keep their costs down.

a BIG JOB..!

● Sutton Company, of Radford, Virginia, now working on the famous Skyline Scenic Highway, makes the following statement:

"... We are entirely pleased with the performance of each and every one of the eight 315 Worthington Diesel-driven Compressors we have been working this past year, and want to congratulate you on the valuable service your firm has rendered us."

Worthington Compressors and Air Tools have cut costs in a big way for Sutton Company on the Skyline Drive.

WORTHINGTON Portable Compressors, Rock Drills and Air Tools have established a new standard in "cost cutting" for the contractor. The famous "Feather Valve" in every Worthington Compressor guarantees the highest efficiency in air production; Worthington engineering skill has developed many outstanding features in Worthington Rock Drills and Air Tools, for greater efficiency and economy of operation. These exclusive features, plus the basic quality of all Worthington Construction Equipment, add up to lower costs for the user.

"More Worthington in '41 will give you More Profit in '41"

There is a Worthington Distributor or Branch Office in your area that will give you prompt local service.

PC1-1

WORTHINGTON

WORTHINGTON PUMP AND MACHINERY CORPORATION · HARRISON, NEW JERSEY

HOLYOKE COMPRESSOR AND AIR TOOL DEPARTMENT
Holyoke, Massachusetts

Private Toll Suspension

BRIDGE COLLAPSES

Built in 1929 at a cost of about $75,000 a 1300 ft. suspension span bridge over the Red River between Telephone, Tex., and Bennington, Okla., to carry loads not exceeding 6 tons capacity, on a Fannin County road, collapsed without loss of life. Writes Jas. E. Pirie, District Engineer, Texas Highway Department:

General View of Collapse. Note Section of Tower Alongside of Cylinder Bent. Towers Still Standing in Background

Recess Left Where Anchor Pulled Out

Section of Anchor Pulled Up Against First Tower Cylinder Bent

"The Telephone bridge north of Honey Grove failed about 11:15 a. m. Wednesday, December 4.

"This structure apparently failed by the simultaneous parting of both of the wire cables at the approximate point of embedment in concrete anchors. After the cables parted in the heavy portion of the anchors a block of concrete of approximately 3 yards in size was pulled out of the ground. One of these blocks being pulled over the end post and falling into the river and the other block, as indicated in pictures, landing at the cylinder.

"Mrs. Freeman, the toll keeper, was replacing some floorboards, having two men and a truck working near the middle of the bridge. She returned to the house about 11:00 a. m. and hearing a noise, went to the front door in time to see the anchors being slowly pulled out of the ground and the bridge gradually settling into the stream. The two workmen had left the truck in the middle of the bridge and were on the north bank so no one was injured. The middle section, carrying the truck, settled to within about 3 ft. of water level and the men went out and cranked up the truck and drove it through the handrail onto the low north bank of river. The bridge settled until it took position shown in pictures."

The photographs and story are published by courtesy of Mr. G. G. Wickline, Bridge Engineer, Texas Highway Department.

This View Shows Some of Details of Construction

View on Center of Roadway Looking Toward Bridge Showing Where Anchors Gave Way

Speed OF OPERATION IS WHAT YOU GET IN THIS MODERN ROAD EQUIPMENT

BUILD MORE DEFENSE ROADS IN LESS TIME

Littleford "Spray Master" Distributor with full circulating spray bar.

Littleford "Tankar" Heater, the fastest steam producing unit ever designed.

Here are the units that have been **Engineered** and **Designed** to give you the **Speed** needed for fast road building and maintenance.

Pressure Distributor—This Littleford Spray Master Pressure Distributor has only one valve for operating the spraying of materials. No gadgets—no maze of valves to slow up operating time.

"Tankar" Heater—This is the fastest steam producing unit ever designed—produces 200 lbs. of steam in 2 minutes, heats one or two tank cars in 1/3 less time than ordinary units. Can also be used as a cleaning outfit.

Road Broom—This two-way Broom can be changed to sweep from one side to the other in 60 seconds—has hydraulic lift to raise or lower broom giving the broom any required tension on the road.

Littleford Two-Way Broom with 60 - second change over.

We need speed today—so speed up your work with a unit guaranteed to **give speed of operation.**

BLACK TOP ROAD MAINTENANCE EQUIPMENT LB SINCE 1900

LITTLEFORD

LITTLEFORD BROS.
454 E. Pearl St., Cincinnati, Ohio

View of Old Road Before Construction Began

REBUILDING COASTAL ROUTE IN MISSISSIPPI

Reconstructing U. S. Route 90, a 20-Year Old 20 Ft. Wide Road in Harrison County as Modern Dual Lane Highway

By G. WALTON THOMPSON

Project Engineer, Mississippi State Highway Department

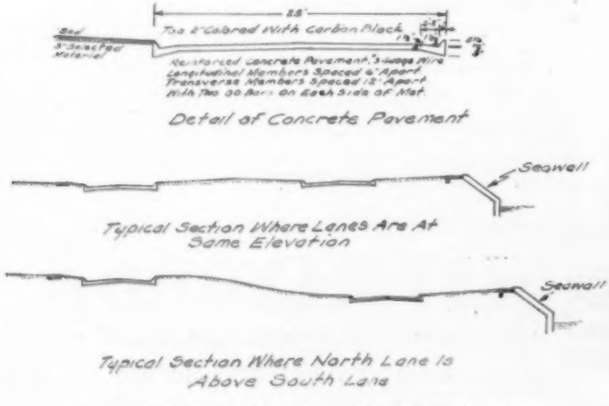
IN KEEPING with the development of a modern highway system, the Mississippi State Highway Department is reconstructing U. S. Route Number 90 through Harrison County. This section of highway runs the length of the county within a few feet of the Gulf of Mexico and offers scenic beauty coupled with transportation facilities such as few communities possess. Full advantage has been taken of these possibilities in the construction of the new road.

The Old Highway

The existing roadway consisted in the main of varying types and thicknesses of asphalt surface material on base courses of varying materials and thicknesses. Several sections had a concrete base while others rested on shell, gravel, asphalt and sand. No uniformity in the construction was evident since the different sections were constructed over a period of 20 years. Short sections of concrete and brick surfacing occurred on the route.

The original road was in the main of 20 ft. width. Its alignment was dictated by the encroachment of the waters from the Gulf of Mexico and the existence of trees of great natural beauty. The fact that these trees were spared without consequent dangerous kinks in alignment is a tribute to either the road-building pioneers of that day or to the old ladies who sat on their porches and dared the construction gang to cut the trees. The construction between 1925 and 1927 of a stepped type seawall across the county put an end to the constant erosion of the gulf and reclaimed much land that had previously been lost.

This seawall was constructed of two heights; namely, 8 and 11 ft. above the mean gulf elevation. It roughly parallels the existing road and was constructed as a road protection measure. During the building of this seawall,


Detail of Concrete Pavement
Seawall
Typical Section Where Lanes Are At Same Elevation
Seawall
Typical Section Where North Lane Is Above South Lane

Detail of Concrete Pavement and Typical Sections

Seawall Showing Both 8 ft. and 11 ft. Sections—Old Road in Background

NEWLY BUILT STATE ROADS NEED REPAIR

'Cheap' Highways Break Up After Brief Use in Various Rural Areas. Maintenance is Costly

heralded

SPRING FINDS STATE ROADS IN POOR REPAIR

Severe Winter Caused Much Damage and Funds Are Low

HIGHWAYS ARE CLOSED TO TRAFFIC OVER 6 TONS

Notices have been received from the state highway department [illegible] the Norwich-Ply[illegible] from the [illegible] Corners [illegible]

IN CONTRAST—

WINTER ROAD DAMAGES PROVE CONCRETE'S VALUE

Millions of Dollars in Frost Erosion Damages on Non-Permanent Pavings, But Concrete Stands Rigid Test

you haven't broken springs [illegible]ouncing over those

CONCRETE ROADS STAND

A drive over State improved highways in almost any section of the State will disclose that concrete roads stood up [illegible] excellent [illegible] the

When spring break-ups come there's "*traffic as usual*" on

CONCRETE

Spring thaws and rains again are causing millions of dollars' damage to roads—but not to concrete roads! Weakened subgrades have little effect on concrete pavement. It carries "traffic as usual" without load restrictions to handicap truckers; without detours and without money-eating spring repairs.

All-Weather Concrete Assures Safe, Dependable Highway Service with Lowest Annual Cost

A concrete road designed for a given volume and weight of traffic *will handle that traffic in any weather.* For concrete's beam strength distributes the load more widely; keeps pressures on weakened subgrades within safe limits. Even after a winter and spring that ruin other roads, inexpensive routine maintenance quickly puts concrete in condition for heavy summer traffic.

Make a personal survey: drive over your roads this spring and compare. You'll find miles of conclusive proof that it pays to build with dependable, all-weather concrete.

PORTLAND CEMENT ASSOCIATION
Dept. A3-28, 33 W. Grand Ave., Chicago, Ill.

A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work

Old Road Before New Construction Showing Difference in Elevation Between Old Road and Fill Adjacent to Seawall

sand was pumped between the seawall and the plateau on which the road lay to the elevation of the wall.

Work Preliminary to Reconstruction

In 1937-38 the state highway department conducted a survey to determine conditions regarding this section of highway. Although most states had only recently begun their studies in cooperation with the U. S. Bureau of Public Roads and Mississippi had not launched its survey at that time, enough information was available for a comprehensive study to be made. From an examination of the results of these investigations it was decided that a dual lane highway carrying two lines of traffic in each direction was needed.

The existing conditions both above and below the ground dictated the necessity for a thorough study and

View Behind Mixer as Strike-Off Is Pulled Ahead

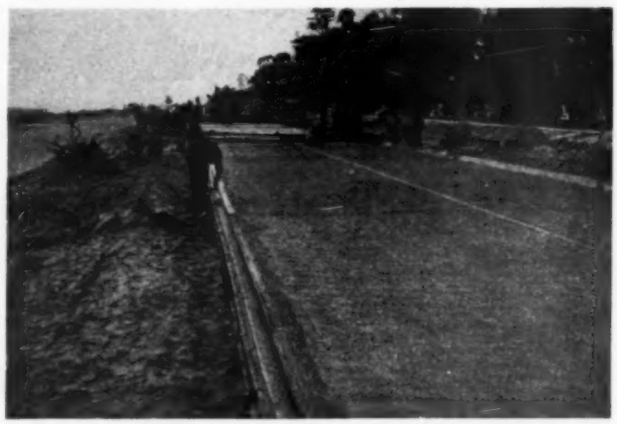
the procurement of all possible information before plans were prepared. As stated before, the construction of the existing surfaces had begun over 20 years before; the roads that preceded these structures had been built possibly 15 years prior; drainage structures from the mainland to the north into the gulf went beneath the existing road and sand fill then through the seawall and finally into the gulf. More than 70 private artesian wells were along this route and their pipes ran in all directions; public utilities ran both above and below the ground. Natural and artificial growths were abundant. No records of existing structures or improvements were available.

In order to correlate as much information as possible a topographic map was made covering an area in width from the seawall on the south to a point 25 feet north of the existing road and extending the full width of the county. This map was made on a scale of 1 inch equals 20 feet and the sections were made as long as possible to prevent errors.

During the mapping operations all physical features above ground were first detailed. The maps were then inked and a level crew placed all pertinent elevations on them. A third crew located all underground structures and placed these with their elevations on the map. A continuous drainage map and aerial mosiacs completed the preliminary layout.

Highway Design Features

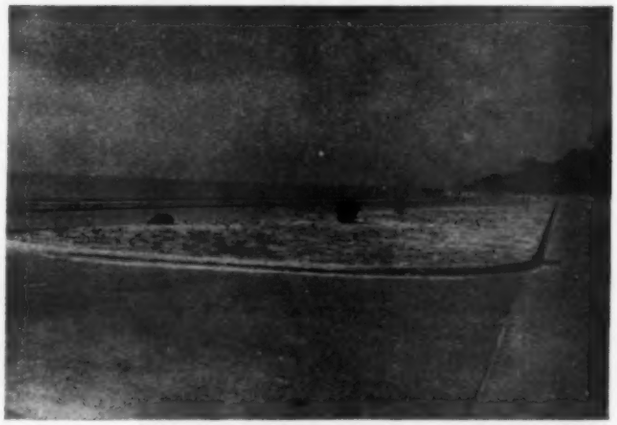
The basic design of this highway is decreed by the peculiarly local conditions of the area through which it passes. Since several municipalities are embraced within its limits, it has been necessary to depart from customary



Finishing Operations Viewed from Completed Portion. Note Cycloid Curb

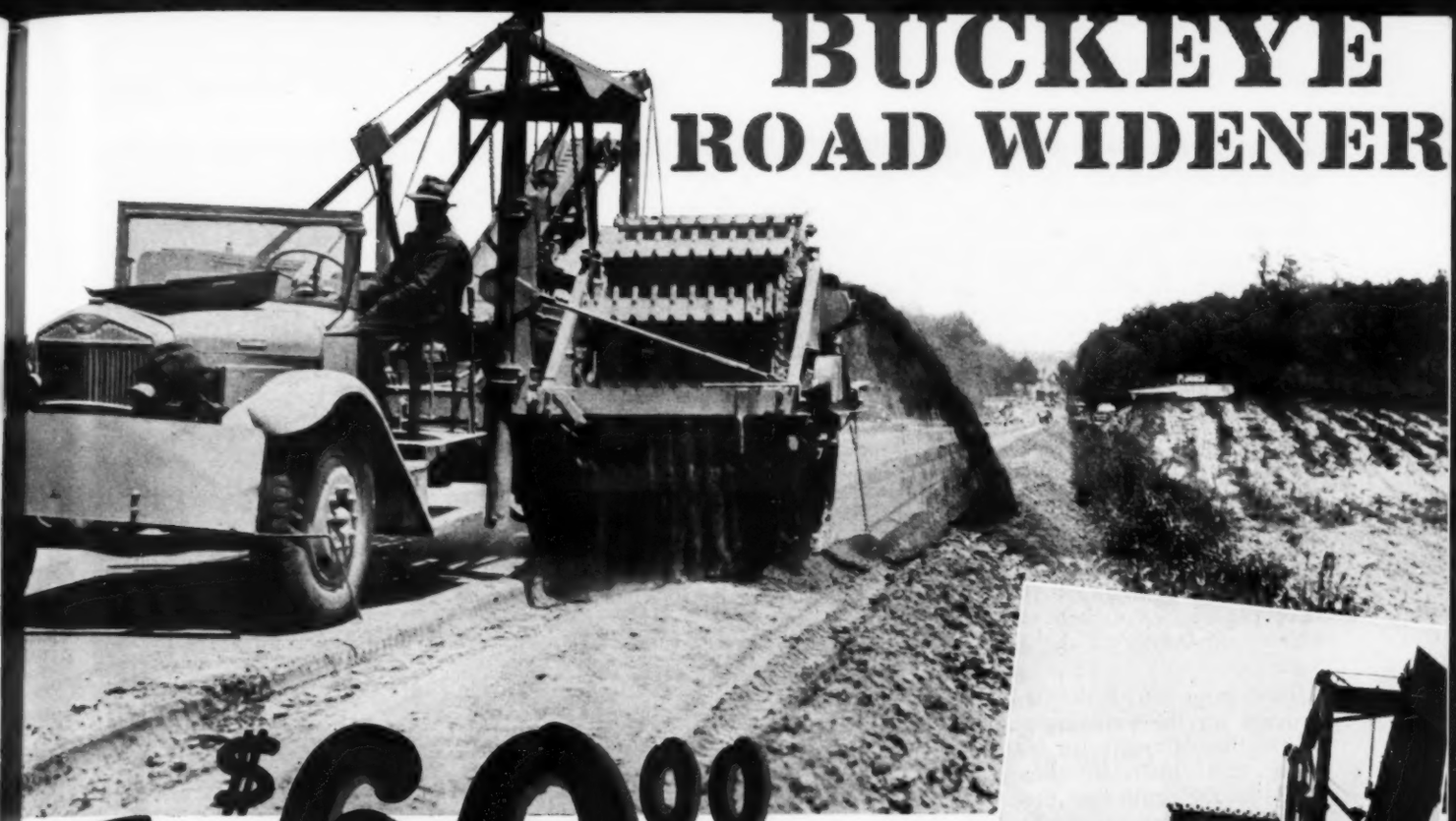
separated lane practice in providing cross-overs at fairly close intervals. These, however, have been kept to a minimum. The native trees which lend beauty to this section have been kept closely in mind from the beginning. This has resulted in a minimum of sacrifice of trees and engineering principles.

The lanes are 24 ft. wide, of 9-6-9 mesh reinforced concrete with a 6 in. integral cycloid curb. To reduce glare, emulsified carbon black at the rate of 2 lb. per bag of cement is mixed with the concrete in the top 2 in. of the pavement. The ¾ in. joints, spaced at 40 ft., are



View Showing Both Lanes and Part of Cross-Over Between

BUCKEYE ROAD WIDENER



Saves $60.00 per day

ON SOUTH CAROLINA JOB!

JOB FACTS

CONTRACT: Four foot widening on one side of Highway 117 in South Carolina between Calypso and Dudley.

CONTRACTOR: Wm. F. Bowe, Jr., Augusta, Georgia.

METHOD OF WIDENING: Subgrade trench dug with a BUCKEYE Model 16-R-4 Highway Widening Machine. Concrete poured between existing slab and 8" steel forms.

DIMENSIONS OF WIDENING TRENCH: 4'-9" wide from edge of existing slab, to allow 4' widening and 9" for setting forms. 8 inches deep—7" for slab and an additional inch below finished finegrade for form line.

SPEED OF TRENCHING: Widening trench cut to specifications at the rate of a mile per day!

DOLLAR SAVING: $60.00 per day saved over previous method of trenching due to speed and accuracy of Buckeye machine!

SAVING ON CONCRETE: Excess of aggregate on 3 miles of work done prior to use of Buckeye Road Widener was 8%. Ability of machine to cut to accurate depth reduced this to 2%!

OTHER ADVANTAGES: Buckeye Widener served as "spark plug" or pace setter for entire job.

See other cost cutting Buckeye equipment on page 27

Go out and look for road widening jobs this year. You can bid low and make a good profit if you base your figures on using a Buckeye Road Widener for the job! Write to Buckeye today and ask for complete information and a bulletin on these money-making machines. BUCKEYE TRACTION DITCHER CO., Findlay, Ohio.

Built by Buckeye

Convertible Shovels

Trenchers

Tractor Equipment

R-B Finegraders

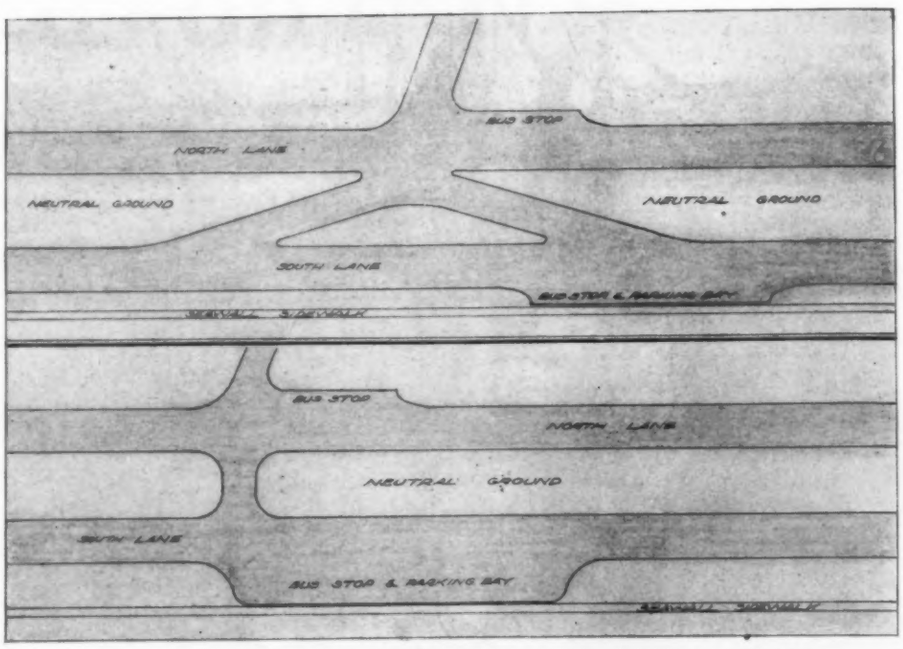
Road Wideners

Spreaders

filled with a mixture of cotton seed hulls and cutback asphalt after being sealed at the bottom with AC-13.

The north lane, for west bound traffic, is frequently at a much higher elevation than the lane to the south. The limited space between the two often precludes the construction of normal cross-overs between lanes. In order to hold grades on cross-overs to a reasonable minimum Y-types of cross-overs are often employed. These serve as acceleration and deceleration lanes to some extent and appear to have contributed to both the safety and beauty of the design.

Bus stops on both lanes provide for the swinging out of the line of traffis for both local and interstate buses while on the south lane parking bays are combined with bus stops to provide residents and tourists an opportunity to stop at frequent intervals.

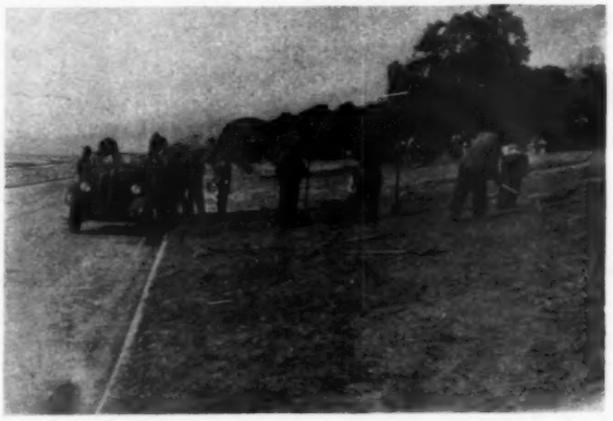


Typical Section; Above, "Y" Type Cross-Over; Below, Normal Cross-Over

Special inlet designs were made to facilitate the entrance into the structures of leaves and pine straw. Without such design the gutters adjacent to structures would become hopelessly clogged due to the flat grades which seldom exceed 0.3 per cent.

The natural beach sand, after being shaped to typical sections, is covered with a 3-in. layer of semi-impervious clay and then sodded. The clay serves to furnish food to the sod as well as to retain moisture near the roots.

One feature that has contributed much to the attractiveness of the project has been the removal of power lines that spanned the entire job. This has been accomplished with the cooperation of the Mississippi Power Co.



Workmen Placing Carpet Grass Solid Sod on Slope of Neutral Ground

The Initial Project

Due to the fact that even after exhaustive study so much remained unknown about underground conditions the construction of the project as a contractual performance was held unfeasible. For instance, each drainage structure had to be investigated in its entirety, its condition determined and necessary repairs or replacements made. Obviously a contract item for such work would be impractical. Numerous other operations fell in the same category.

Lanes. Neutral Ground Shaped for Placing of Selected Material Workmen Placing Bermuda Sprigs in Neutral Ground

With these facts in mind the state highway department submitted an application to the Works Projects Administration for an initial project embracing 4.75 miles. Work was begun in June, 1939.

As the project was originally set-up the state highway department was to furnish most of the equipment and materials while the W.P.A. was to supply the labor and approximately one-sixth of the materials. However a dearth of finishers and other skilled laborers on the W.P.A. rolls transferred the burden of furnishing these workmen to the state highway department. Most of the equipment used on the initial project which was furnished by the state highway department was purchased new. The paving equipment, however, was rented by contract on a monthly basis. It is anticipated that new paving equipment will be purchased for subsequent operations.

SPEED IN EVERY OPERATION CUTS COST

12 YARD KOEHRING TRAIL-DUMP

LOWER DIRT-MOVING COSTS . . . are possible only if all operations are fast . . . loading, traveling, dumping and turning. If any one operation is slow, the time cycle is lengthened, less dirt is hauled per hour . . . and costs go up. Wide body for fast loading . . . power and flotation for high speed travel . . . instantaneous gravity dump . . . short turning radius . . . all combined for high speed operating cycle . . . more loads per hour . . . more dirt per shift.

KOEHRING COMPANY
MILWAUKEE • WISCONSIN

HEAVY-DUTY CONSTRUCTION EQUIPMENT

View Showing Part of Leg of Y-Type Cross-Over, South Lane and Combined Bus Stop and Parking Bay

Construction Features

The construction features of the project with some exceptions follow those of similar construction. Grading operation are simplified by the nearby seawall. Since an excess of sand occurs in most sections this granular material is simply pushed over the seawall by a bulldozer

Completed Section of Project. Bus Stop in Upper Right Center and Parking Bay in Upper Left Center

and it is restored to the beach by the first heavy rain.

The old pavement has been removed by pry-poles, paving breakers and small cranes. The municipalities have cooperated in salvaging the existing curb and gutter sections. These have been removed intact, hauled to a new location and laid to line and grade to form the framework for newly paved streets.

Completed Section of Project

After paving operations are completed and the neutral ground is shaped, solid sod, such as carpet grass is placed on all slopes and where needed to match existing lawns. Where the sod is likely to be exposed to salt spray bermuda grass is used since it has been demonstrated that this species of grass quickly recovers from even an inundation in sea water of several hours.

In the seawall as constructed, the transitions from the 11 ft. wall to the 8 ft. sections were effectuated within 85 ft. On this project the transition has been lengthened to 280 ft. and parallels the grade of the south lane.

Construction Equipment

Accurate cost records have shown that the construction work is being done economically and that the unit costs compare favorably with estimated costs on a contract basis.

The main items of equipment used are as follows:

1 Rex paver 27E
1 Ord finishing machine 25 ft. roadway
1 Carr trail grader 25 ft. roadway
1 Jaeger pump 800 GPM
1 set Blaw-Knox bins 2-compartment
1 Lakewood subgrader 25 ft. roadway
1 Koehring crane
1 Construction Machinery Co. mixer 10-S
1 International bull grader TD-40.

The Mississippi State Highway Department is sponsor of the project. The work is being done under R. A. Harris, Chief Engineer, J. D. Lewis, District Engineer, with G. Walton Thompson as Project Engineer. The Works Projects Administration is represented by T. O. Mabry, District Engineer, and G. C. Lewis, Project Supervisor.

PAINTING SAN FRANCISCO-OAKLAND BAY BRIDGE

Painting constitutes the largest single item of maintenance of the San Francisco-Oakland Bay Bridge. According to the statement of Ralph A. Tudor, Principal Bridge Engineer, in the recently issued report of the California Division of Highways, $108,290 was spent on this work during the fiscal year ending June 30, 1940. There are approximately 15,000,000 sq. ft. of steel surface to be maintained and it is anticipated that this will be covered on about a five-year cycle. During the year, 7327 gal. of paint were applied. On the whole, weather was good and about 86 per cent was permissible for painting. The previous year had a corresponding figure of about 82 per cent. The crew includes 34 painters, two foremen and 8 miscellaneous employees.

Several items of equipment were added during the year. In particular, the number of steam cleaning units was increased from one to three. This method of cleaning the steel prior to repainting has proved to be satisfactory and economical. Painting scaffolds were purchased and erected to facilitate access to the underside of the lower deck of the East Bay spans and the outside surfaces of the suspension bridge towers. There were also installed two additional painting gantries which are mounted on the lower roadway curbs to straddle the truck deck and thus make accessible the under surface of the upper deck. These gantries have extendable cantilever arms which reach above the electrified catenary system of the interurban tracks and permit painting operations in this area. Two 105 cu.-ft. portable compressors and 11 pneumatic buffers were added to painting equipment during the year.

HERE'S WHY

You finish "in the Money"

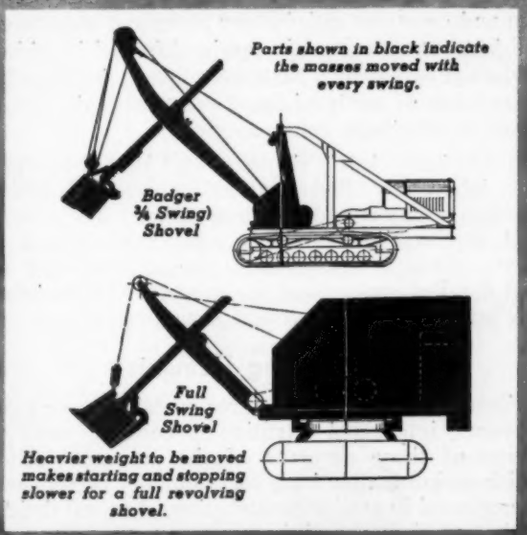
WITH A BADGER ½ YARD SHOVEL

● Any good operator can put more dirt where you want it, with a Badger than with any other shovel of its size and price.

You can readily see why this is so, for the Badger has no machinery deck to swing, and therefore starts, swings and stops faster—and it's more swings per hour that puts more dirt in the trucks for more money on any contract.

The Badger is easy to haul at truck speeds on its own wheel mounts, and when you get it to the job you've got a real dirt mover.

Ask for engineering specifications, low first cost . . . and PROOF that you can get more done quicker, and at less cost, with a BADGER. THE AUSTIN-WESTERN ROAD MACHINERY CO., Aurora, Illinois.


Parts shown in black indicate the masses moved with every swing.
Badger ¾ Swing) Shovel
Full Swing Shovel
Heavier weight to be moved makes starting and stopping slower for a full revolving shovel.

Austin-Western

MOTOR GRADERS
LOADERS
BLADE GRADERS
ELEVATING GRADERS
HYDRAULIC SCRAPERS
CRUSHING AND SCREENING PLANTS
CABLE SCRAPERS
ROLLERS
ROLL-A-PLANES
MOTOR SWEEPERS
BITUMINOUS DISTRIBUTORS
SHOVELS AND CRANES

Remarks Regarding

AIRPORTS RUNWAY SURFACINGS

By H. H. HOUK

Engineer, Washington National Airport, Federal Interdepartmental Engineering Commission

THE objective of all transport is to overcome the handicaps of distance in the movement of men and goods. Movements on the ocean and in the air proceed on quite definite but wide sea lanes and airways, but Ground movements of aircraft are confined necessarily to comparatively narrow prepared traffic ways. These ground movements necessitate prepared landing strips with or without surfaced runways to insure safe, rapid, uninterrupted movement of aircraft on the travelled ground paths of the landing field, air base or airport. Since air transport has reached that stage of development where it must take off and land regardless of soil conditions, airport engineers are faced with the problem of fulfilling the ever-increasing demand for all weather runways at a cost that the public is willing and able to pay.

The area of landing strips is so extensive that the cost of paving runways thereon, added to the cost of grading, drainage, necessary appurtenances and incidentals call for money outlays so large that unless the utmost in economy is achieved, the public will be burdened, needed facilities will not be provided and the progress of aviation will be retarded. This urgent need is stimulating the airport engineer to exhaustive research to adapt and discover satisfactory and economic solutions. He welcomes the challenge to conceive, design and construct satisfactory pavement structures that will last out an economic service life and is taking full advantage of simple basic principles, developed after many years of costly trial-and-error methods in railway, street and highway construction.

It has been clearly demonstrated that thorough field and laboratory investigation; unbiased engineering selection; experienced, prudent design; workable, practical specifications; suitable, efficiently utilized equipment; planned construction procedures; and intelligent detailed supervision are necessary to produce durable and economic pavement structures.

Surfacing Elements

Since all pavement structures contain one or more soil elements, intensified attention is being devoted to the design of those elements of the pavement structures which unfortunately have so frequently been overlooked or neglected in earlier construction. Natural deficiencies in the soil elements of the pavement structure are being corrected where practicable and economical. The soil mass is being strengthened by the addition of requisite materials prior to mixing with the binder or the replacement of unsatisfactory material with satisfactory soil material. This procedure is preferable to attempting to overcome soil weaknesses through the substitution of more costly non-soil elements or through increase in the thickness of surface courses.

Searching thought and investigation is being directed toward the elimination of specification requirements that manifestly add nothing to the pavement structure except delay and expense, or that obviously increase its unit cost beyond the service value of any presumable improvement in quality or service life. Specifications are being drafted to best utilize such suitable construction materials as are economically available with a minimum of hauling, handling, processing and waste.

Wide pavements become progressively uneven with each successive year to a degree dependent upon soil and climate conditions. The likelihood that resurfacing will eventually be required is receiving proper consideration. It is realized that the more unfavorable these conditions, the earlier resurfacing will be necessary. Transverse slopes of runways are being held to the minimum percent necessary to insure, under prevailing construction and soil conditions, that settlement of the supporting soil layers will not change the surface contour of the cross-section or the profile sufficiently to create depressions that will hold water before normal maintenance resurfacing will become necessary.

The contours of the areas common to two or more runways are carefully planned and drawn to large scale to obtain smooth riding and well drained intersections.

The large volume of water that falls on the surface of the large areas of slightly permeable and impervious material must be collected and removed fast enough and in a manner that will avoid hazardous collections or sogginess. Wherever French drains are used, extreme care is being taken in the selection and placement of a proper gradation of porous fill material and in the design and placement of a top layer over that fill which will not be displaced or become clogged. Drainage inlets and catch basins carry the plane wheel loads that may pass over them.

The transition strip from stabilization or pavement to ordinary soil or turf is more critical and more hazardous than the shoulder junction of highway pavement and every effort is being made to minimize the effects of discontinuity and prevent softening, sogginess and scour. Investigations indicate that this can be accomplished by a stabilized soil course specially prepared and constructed to provide a combination of maximum stability with sufficient plant food and moisture to sustain a resistant grass mat.

Pavement Surface Conditions

Impermeability and skin-resistance is being built into runway pavement structures. Many loosely mixed types, successful for highway use, have been found unsuitable for airport use because they depend upon the kneading action of dense traffic to finish their construction. Alternate freezing and thrawing is destructive to any pavement surface sufficiently porous to admit appreciable

quantities of moisture. Skid resistance is obtained by the use of dense, rather than loose mixes. An anti-skid surface need not be an extremely coarse textured surface with large-sized exposed aggregate, but the surface must be gritty or granular with a sand paper like texture. Even sheet asphalt and over-sanded concrete pavements, properly designed and finished are quite skid resistant.

In order to prevent the formation of an unbroken film of water over the surface when wet, it is desirable that the surface be pitted, indented or grooved, but these irregularities need not exceed one-fourth inch in depth in any case. Excessive manipulation, vibration and finishing of concrete draws an excess of Portland cement to the surface and excessive rolling of asphaltic types may draw an excess of asphaltic cement to the surface. In either case a polished or glazed surface, slippery and glaring when wet, will result. Good construction avoids this condition.

Wear and tear of traffic is a less important factor in the design of stabilization and necessary airport runway pavements structures than in highway pavements. One hundred per cent traffic service is all that can be provided by any design, material, or expenditure, and any immediate expense incurred beyond the amount necessary to provide that full measure of service should be justified by planned stage development or expected future requirements.

Concluding Observations

Already too many partial or total runway stabilization or pavement failures are traceable to an ill-chosen type, improper design, incompetent inspection or unseasonable construction. Through complete laboratory and careful field investigations, much of the guess work is being removed from the design of the soil elements of pavement structures by the application of the recently developed soil research technique. However, it must be realized that the application of practical knowledge gained from observation of the behavior of the particular soil under similar service conditions coupled with experienced construction inspection is still necessary to minimize uncertainty and to obtain soil elements of predictable behavior.

Good natural and well-constructed soil elements are the most permanent elements of any stabilization of pavement structure, but to prepare and produce them requires more intelligent design, more experienced construction and more detailed inspection than do the non-standardized non-soil elements.

In an emergency, the engineer must be on guard against the inherent faults that arise in rapid and unseasonal construction.

The airplane is here to stay and increase in its utilization in everyday life will eventually demand that every city and community have ample facilities for this new form of transport. The only question is how soon and how well its operation requirements will be met.

The airport engineer has a major problem on his hands. We know now that the principles applied ten and fifteen years ago were expedients only and few of the fields of that day offer satisfactory facilities today. We cannot afford to repeat those previous mistakes in design, over and over again, and our fields of today must anticipate and be prepared to meet the demand of ten and twenty years of additional development of air transport. The airport must always be ahead of the demands of air transport.

▼

NEW YORK PROFESSIONAL ENGINEERS TO MEET IN MAY

The New York State Society of Professional Engineers, Inc., will hold its annual convention at the Hotel Commodore, New York City, May 8th, 9th and 10th, 1941. A feature will be an exhibit of equipment, supplies and methods in the engineering field. Companies supplying the engineering field will be the exhibitors.

The success of an exhibit held several years ago led to adoption as an annual feature of the convention. A number of leading companies have already announced their intention of exhibiting.

The New York State Society is composed of professional engineers licensed to practice by the state. Member attendance at the convention is around 1,000. Because of the exhibit feature, the society will extend invitations to attend to all professional engineers in New Jersey and Connecticut, as well as New York. Offices of the society are at 1941 Grand Central Terminal, New York, N. Y.

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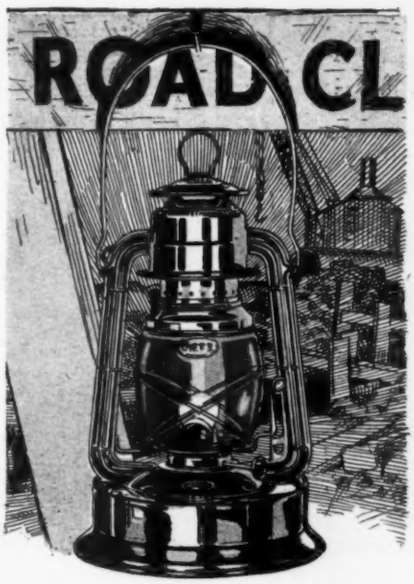
Taxation of Diesel Fuel.—Increasing legislative attention to the taxation of motor fuel, other than gasoline such as diesel fuel, is indicated by use fuel taxes presented in Arizona and Utah.



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EFFECT OF GRADING AND ADMIXTURES

On Compressive Strength and Capillary Water Absorption of Soil Base Course Mixtures.

By J. B. GARNEAU, F.C.I.C.
Chief Chemist, and
C. E. BELAND, F.C.I.C.
Assistant Chief Chemist,
Quebec Highways Department

MILITARY aspects of highway construction are now to be considered besides the commercial purposes and the need for all-weather, strong and stable roads cannot be overemphasized.

It is now admitted that any type of pavement, rigid or flexible, to be most satisfactory and durable must rest on a sound, stable subgrade or it must have a base course of sufficient thickness* and stability to transmit the loads and shocks from the pavement or wearing course to the subgrade without weakening its supporting power at any place.

A few natural soils are stable enough to carry pavements and low-cost surfaces satisfactorily; most need be treated or stabilized to support loads conveniently, regardless of climatic conditions.

$$t = b\,\frac{p_o - 4m_2}{4m_1} + \frac{bm_2}{p_o}$$

where t = Thickness of base course required.
b = Diameter of the bearing area.
p_o = Tire pressure.
m_1 = Shearing resistance of the base course.
m_2 = Shearing resistance of the clay subgrade soil.

It is essential that mixtures having the proper characteristics be used in the construction of base courses, because troubles in foundations cannot be corrected so easily as in surface courses and may result in expensive failure of the entire road structure.

In the past it has been thought that a base, when covered with a pavement or bituminous surfacing, would provide an all-weather road. This was true when the base course material was dry, but such roads could not be travelled upon in the thawing period owing to the poor bearing capacity of the foundation.

* The thickness of such a base can be satisfactorily determined by the following Housel formula:

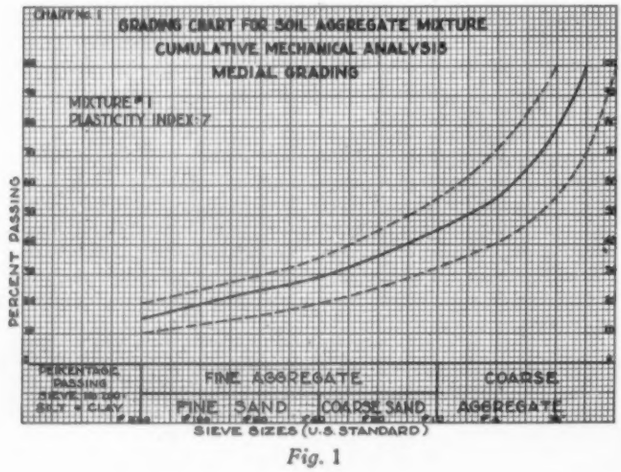


Fig. 1

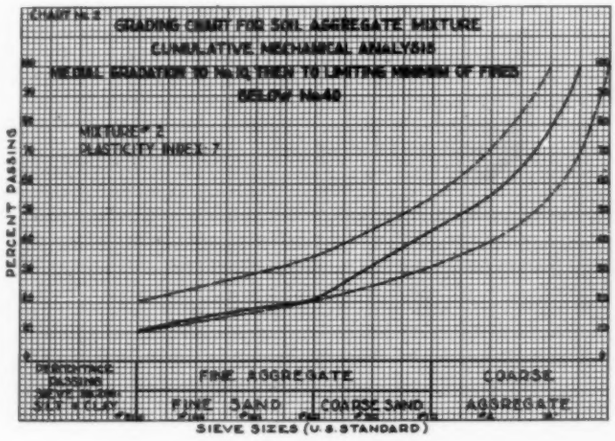


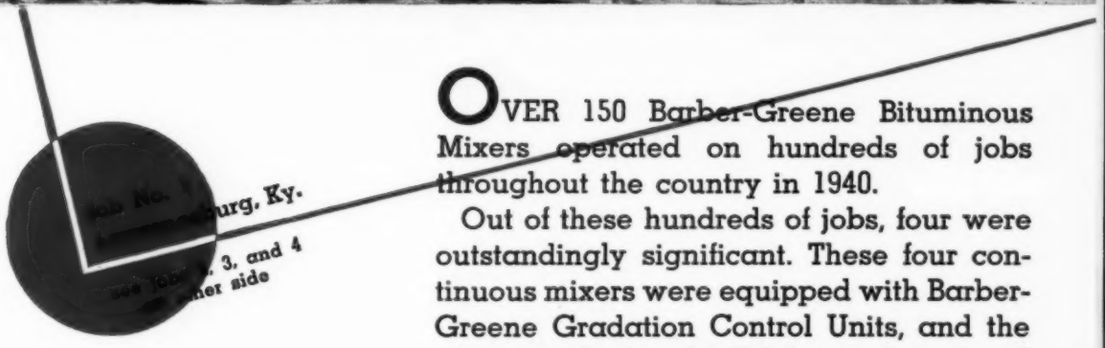
Fig. 2

Confronted with this trouble, road executives tried several admixtures with the soil aggregate, which were reputed to increase the stability of gravel base courses; in Quebec, only sodium chloride was used for that purpose. As the use of this chemical produced no apparent improvement in the stability of the roads in the spring time, samples of salt-stabilized base courses were taken in the middle of May, 1940, to detect the right causes of their poor bearing values in the thawing period. The base material, easily disturbed by means of picks, was collected in moisture-proof containers and possessed, when tested, a moisture content varying between 4 and 6 per cent.

The shearing strength which is an important factor to take into account, when computing the thickness of the base course by the Housel formula, is the resultant of friction and cohesion in soils and is indicative of stability; it varies between one-third and one-half of their compressive strength and is lowered as their moisture content increases. Consequently, compressive strength and capillary water absorption are two important properties of soil-aggregate base course mixtures from the standpoint of service behavior.

To secure the fundamental engineering data required for the intelligent design and construction of stabilized soil base courses, a co-operative research program was carried out during last winter and spring under the direction of a well-known Canadian soil scientist, Dr. N. W. McLeod, and was participated in by the Queen's University, Kingston, the Ontario Highway Department, L'Ecole Polytechnique, Montreal, the Imperial Oil Re-

Four Significant Jobs



OVER 150 Barber-Greene Bituminous Mixers operated on hundreds of jobs throughout the country in 1940.

Out of these hundreds of jobs, four were outstandingly significant. These four continuous mixers were equipped with Barber-Greene Gradation Control Units, and the plants applied to the "high type hot mixes" on four widely separated locations. We engaged a competent private laboratory to follow each job thoroughly, and invited Federal, State, and City Engineers to witness each job in operation, take samples, and make analyses in their own laboratories.

The results are startling. See other side.

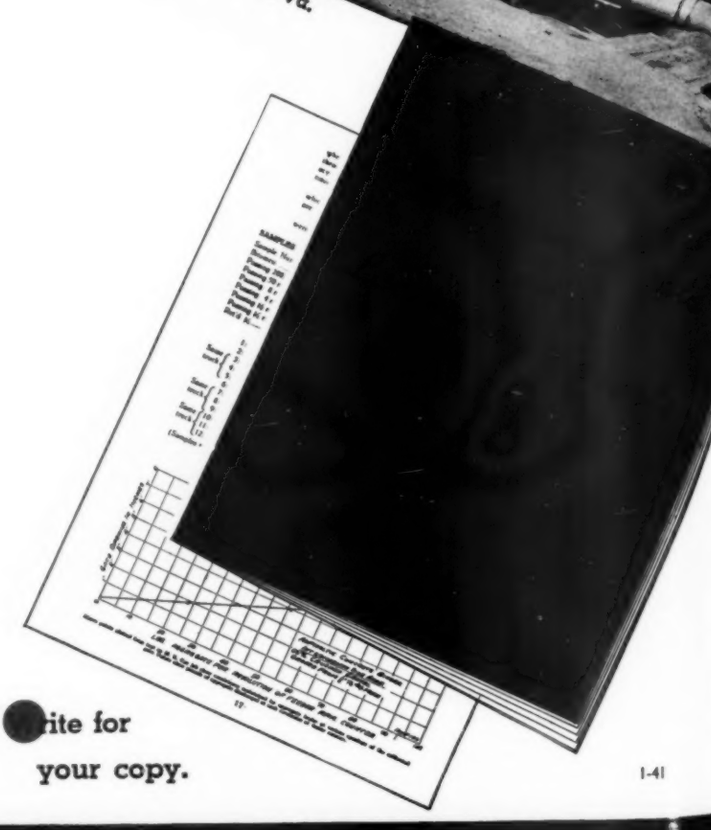
4 Significant Jobs

Job No. 2—Helen, Ga.

Job No. 4—Kansas City, Mo.

Job No. 1
Shown on
Reverse
Side

Job No. 3—Aurora, W. Va.



IN 1940 Barber-Greene Mixers were set up for the "high type hot mixes" on four widely separated locations. They herald a new era in bituminous construction. The performance data and laboratory reports have been assembled into a booklet, available on request. Not a picture book, it gives the *results* of applying the modern production principle of continuous flow to the "high type hot mixes". It will answer the questions of those who are *sincerely skeptical.*

The B-G Central Plant includes the Dryer, Gradation Control Unit (Screen, Bins, Apron Feeder, and Calibrated Gates), and Mixer. It gives the finest means of preparing the "high type hot mixes". By "finest" we mean from every angle, including accuracy, consistency, ease of inspection, high capacity, portability, versatility, and economy.

The units can be used in any desired combination, including Single Aggregate Central Set-ups, and Travel Plant work.

It will not be surprising if the introduction of the continuous plant on "all type" mixes is opposed — by some wanting only complete proof and demonstration — by others who have financial or other interests in less portable, less versatile, or less modern equipment. We conscientiously believe that these groups will serve their own interests by studying the booklet. Already some producers have expressed interest in supplementing their present permanent equipment with a portable continuous plant, in order to more economically supply the more distant areas of their present markets.

Write for your copy.

1-41

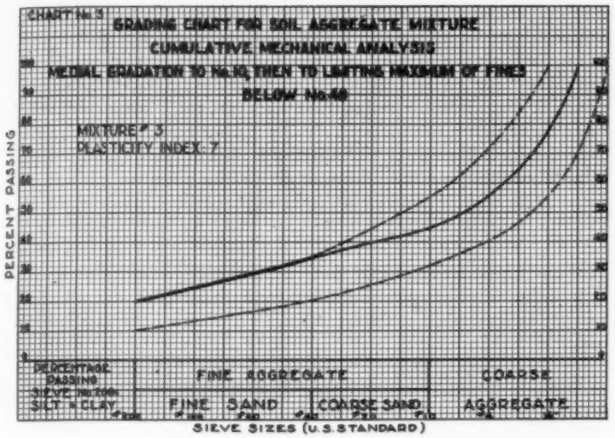


CHART No. 3
GRADING CHART FOR SOIL AGGREGATE MIXTURE
CUMULATIVE MECHANICAL ANALYSIS
MEDIAL GRADATION TO No. 10, THEN TO LIMITING MAXIMUM OF FINES BELOW No. 40
MIXTURE # 3
PLASTICITY INDEX: 7
PERCENT PASSING
PERCENTAGE PASSING SIEVE, INCLUDING SILT & CLAY
FINE AGGREGATE
COARSE AGGREGATE
FINE SAND
COARSE SAND
SIEVE SIZES (U.S. STANDARD)

Fig. 3

search Department, Sarnia, and our Quebec Highways Laboratory.

Variable Gradations Studied

As the definite gradation limits required for mechanically stabilized soil base courses are difficult to obtain in certain localities, a part of our investigational work consisted of finding out the effect of various gradings of aggregates on their compressive strength, and capillary water absorption in order that we might know how far from the ideal gradation we could safely venture.

It is now recognized that water absorbed by a soil-aggregate rapidly lowers its dry compressive strength. Our research work was also aimed at getting definite information as to the extent and the rate of such a drop in compressive strength as the moisture content increases.

Quite a few admixtures have been suggested for improving the stability of soil-aggregate mixtures: Our research program comprised a fair comparative trial of all these so-called "stabilizers" in order to determine their respective effectiveness and influence on the compressive strength and capillary water absorption of soil base course mixtures.

Aggregates. — The aggregates used consisted of coarse aggregate, half crushed and half round, four sands and a clay with a plasticity index of 22, the sieve analysis of which was the following:

Sieve	Crushed Gravel	Round Gravel	Sand No. 4-No. 10	Washed Sand	Sand E	Sand C	Clay 22 P.I.
Retained on 1 in.	3	....	....	....	....	....	....
Pass. 1 in. Ret. on ¾ in.	42	45	....	....	....	....	....
Pass. ¾ in. Ret. on ½ in.	42	39	....	....	....	....	....
Pass. ½ in. Ret. on No. 4	12	16	....	1	....	....	....
Pass. No. 4 Ret. on No. 10	1	....	100	24	....	....	....
Pass. No. 10 Ret. on No. 40	....	....	....	58	10	1	....
Pass. No. 40 Ret. on No. 100	....	....	....	14	90	6	....
Pass. No. 100 Ret. on No. 200	....	....	....	2	....	38	5
Pass. No. 200	....	....	....	1	....	55	95

The aggregates were so combined as to give a constant plasticity index of 7, according to the following formula:

$$P.I. = \frac{P_1S_1M + P_2S_2N + P_3S_3T + P_4S_4X + P_5S_5Y + P_6S_6Z}{S_1M + S_2N + S_3T + S_4X + S_5Y + S_6Z}$$

where $P.I.$ = plasticity index of mixture = 0
P_1 = plasticity index of coarse aggregate = 0
P_2 = plasticity index of No. 4-No. 10 sand = 0
P_3 = plasticity index of washed sand = 0
P_4 = plasticity index of sand E = 0
P_5 = plasticity index of sand C = 0
P_6 = plasticity index of clay = 22
S_1 = percentage of coarse aggregate passing No. 40 = 0
S_2 = percentage of No. 4-No. 10 sand passing No. 40 = 0
S_3 = percentage of washed sand passing No. 40 = 17
S_4 = percentage of sand E passing No. 40 = 90
S_5 = percentage of sand C passing No. 40 = 99
S_6 = percentage of clay passing No. 40 = 100
M = percentage of coarse aggregate in mixture
N = percentage of No. 4-No. 10 sand in mixture
T = percentage of washed sand in mixture
X = percentage of sand E in mixture
Y = percentage of sand C in mixture
Z = percentage of clay in mixture.

Example of Calculation of P. I.—In Table I, for example, where the grading is medial, the plasticity index

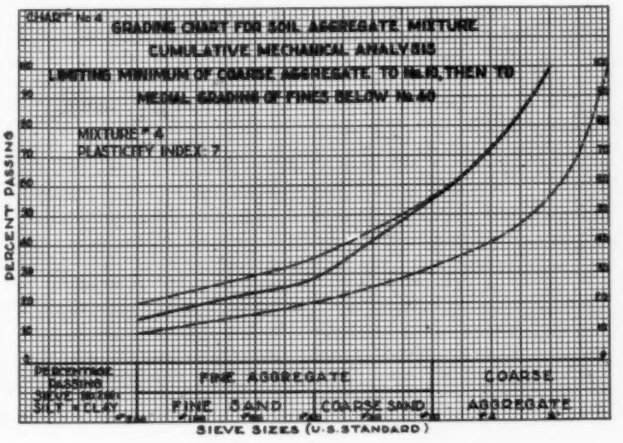


CHART No. 4
GRADING CHART FOR SOIL AGGREGATE MIXTURE
CUMULATIVE MECHANICAL ANALYSIS
LIMITING MINIMUM OF COARSE AGGREGATE TO No. 8, THEN TO MEDIAL GRADING OF FINES BELOW No. 40
MIXTURE # 4
PLASTICITY INDEX: 7
PERCENT PASSING
PERCENTAGE PASSING SIEVE, INCLUDING SILT & CLAY
FINE AGGREGATE
COARSE AGGREGATE
FINE SAND
COARSE SAND
SIEVE SIZES (U.S. STANDARD)

Fig. 4

of 7 is obtained when $M = 45$, $N = 3$, $T = 28$, $X = 4$, $Y = 11$, and $Z = 9$, as follows:

$$P.I. = \frac{(0x0x45) + (0x0x3) + (0x17x28) + (0x90x4) + (0x99x11) + (22x100x9)}{(0x45) + (0x3) + (17x28) + (90x4) + (99x11) + (100x9)}$$

or $P.I. = \frac{19800}{2825} = 704.$

To study the effect of grading, the soil-aggregate mixtures were so arranged as to meet the nine following gradings:

1. Ideal or medial gradation (see Figure 1 and Table I).
2. Medial gradation to No. 10, then to limiting maximum of fines below No. 40 (see Figure 2 and Table II).

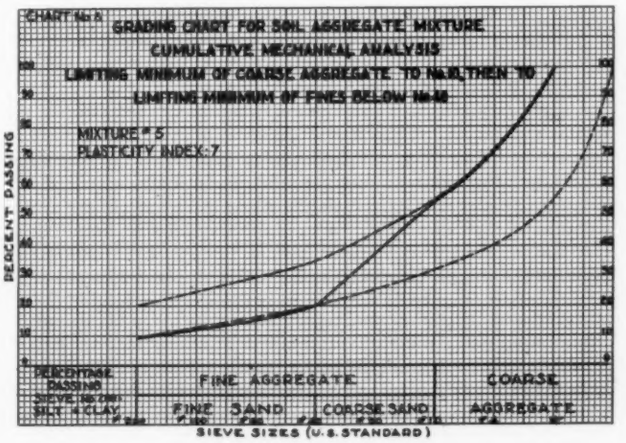


CHART No. 5
GRADING CHART FOR SOIL AGGREGATE MIXTURE
CUMULATIVE MECHANICAL ANALYSIS
LIMITING MINIMUM OF COARSE AGGREGATE TO No. 8, THEN TO LIMITING MINIMUM OF FINES BELOW No. 40
MIXTURE # 5
PLASTICITY INDEX: 7
PERCENT PASSING
PERCENTAGE PASSING SIEVE, INCLUDING SILT & CLAY
FINE AGGREGATE
COARSE AGGREGATE
FINE SAND
COARSE SAND
SIEVE SIZES (U.S. STANDARD)

Fig. 5

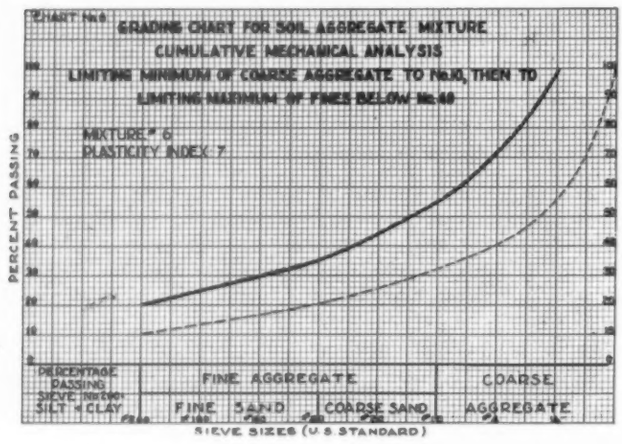


Fig. 6

3. Medial gradation to No. 10, then to limiting minimum of fines below No. 40 (see Figure 3 and Table III).

4. Limiting minimum of coarse aggregate to No. 10 then to medial grading of fines below No. 40 (see Figure 4 and Table IV).

5. Limiting minimum of coarse aggregate to No. 10, then to limiting minimum of fines below No. 40 (see Figure 5 and Table V).

6. Limiting minimum of coarse aggregate to No. 10, then to limiting maximum of fines below No. 40 (see Figure 6 and Table VI).

7. Limiting maximum of coarse aggregate to No. 10, then to medial grading of fines below No. 40 (see Figure 7 and Table VII).

8. Limiting maximum of coarse aggregate to No. 10, then to limiting minimum of fines below No. 40 (see Figure 8 and Table VIII).

9. Limiting maximum of coarse aggregate to No. 10, then to limiting maximum of fines below No. 40 (see Figure 9 and Table IX).

TABLE I

MEDIAL GRADATION

	Per Cent	Per Cent	Coarse 45 Per Cent	No. 4-No. 10 3 Per Cent	Washed Sand 28 Per Cent	Sand E 4 Per Cent	Sand C 11 Per Cent	Clay 22 P.I. 9 Per Cent
Pass. 1 in. Ret o.n No. 4	100	45	45	....	....	....	....	....
Pass. No. 4 Ret. on No. 10	55	11	....	3	8	....	....	....
Pass. No. 10 Ret. on No. 40	44	16	....	....	16	....	....	....
Pas. No. 40 Ret. on No. 100	28	8	....	....	3	4	1	....
Pass. No. 100 Ret. on No. 200	20	5	....	....	1	....	4	....
Pass. No. 200	15	15	....	....	....	....	6	9

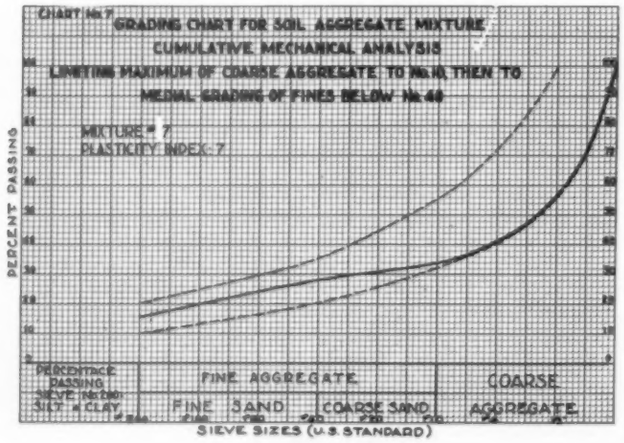


Fig. 7

TABLE II

Medial grading to No. 10, then to limiting mininum of fines below No. 40

	Per Cent	Per Cent	Coarse 45 Per Cent	No. 4-No. 10 2 Per Cent	Washed Sand 40 Per Cent	Sand C 7 Per Cent	Clay 22 P.I. 6 Per Cent
Pass. 1 in. Ret. on No. 4	100	45	45	....	....	....	....
Pass. No. 4 Ret. on No. 10	55	11	....	2	9	....	....
Pass. No. 10 Ret. on No. 40	44	24	....	....	24	....	....
Pass. No. 40 Ret. on No. 100	20	6	....	....	6	....	....
Pass. No. 100 Ret. on No. 200	14	4	....	....	1	3	....
Pass. No. 200	10	10	....	....	....	4	6

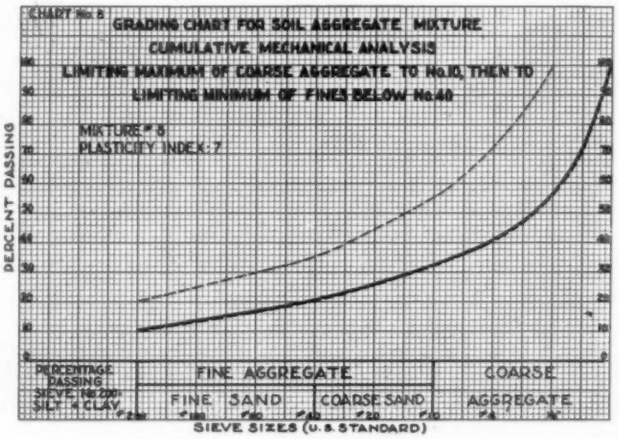


Fig. 8

TABLE III

Medial gradation to No. 10, then to limiting maximum of fines below No. 40

	Per Cent	Per Cent	Coarse 45 Per Cent	No. 4-No. 10 8 Per Cent	Washed Sand 14 Per Cent	Sand E 9 Per Cent	Sand C 100-200 3 Per Cent	Sand C Min 200 10 Per Cent	Clay 22 P.I. 11 Per Cent
Pass. 1 in. Ret. on No. 4	100	45	45	....	....	....	....	....	....
Pass. No. 4 Ret. on No. 10	55	11	....	8	3	....	....	....	....
Pass. No. 10 Ret. on No. 40	44	9	....	....	8	1	....	....	....
Pass. No. 40 Ret. on No. 100	35	10	....	....	2	8	....	....	....
Pass. No. 100 Ret. on No. 200	25	5	....	....	1	....	3	....	1
Pass. No. 200	20	20	....	....	....	....	....	10	10

TABLE IV

Limiting minimum of coarse aggregate to No. 10, then to medial grading of fines below No. 40

	Per Cent	Per Cent	Coarse 28 Per Cent	No. 4-No. 10 7 Per Cent	Washed Sand 45 Per Cent	Sand C 12 Per Cent	Clay 22 P.I 8 Per Cent
Pass. 1 in. Ret. on No. 4	100	28	28	....	....	....	....
Pass. No. 4 Ret. on No. 10	72	17	....	7	10	....	....
Pass. No. 10 Ret. on No. 40	55	27	....	....	27	....	....
Pass. No. 40 Ret. on No. 100	28	8	....	....	7	1	....
Pass. No. 100 Ret. on No. 200	20	5	....	....	1	4	....
Pass. No. 200	15	15	....	....	....	7	8

Two BIG features

Side plates are extended well ahead of the cutting edge to eliminate side spilling of dirt while spreading or loading.

Load can be dumped and spread on side slopes because of accurate control, wide wheel spread, and low center of gravity.

The dirt rolls easily out of the bowl and underneath the scraper, no power wasted bulldozing it under.

Part of a load can be dumped in one place and the rest of it dumped in another, tilting bowl is easily controlled.

1 - Controlled Depth of Spread . . . . .

You get exactly the depth of spread you want with the new Bucyrus-Erie 4-Wheel Scrapers. As dirt is rolled out of the bowl it is leveled off by the cutting edge. Since this cutting edge is fixed in the frame and controlled by a separate line of cable, independently of the tilting of the bowl, it maintains the depth of spread you want at all times.

2 - Positive Rolling Ejection . . . . .

You also get positive rolling ejection, by means of the tilting bowl. Controlled by an independent line of cable, this bowl ejects the dirt in a rolling motion when tilted upward. It can be tilted to a nearly vertical position, and this sharp angle of tilt plus the shearing action along the side plates of the frame assures you clean dumping of any kind of material.

Of course the new Bucyrus-Erie scrapers have all the other features. There is a complete range of sizes matched to the new line of International TracTracTors. Find out all about them from your nearest International TracTracTor Dealer.

Bucyrus·Erie

SOUTH MILWAUKEE, WISCONSIN

TABLE V

Limiting minimum of coarse aggregate to No. 10, then to limiting minium of fines below No. 40

	Per Cent	Per Cent	Coarse 28 Per Cent	No. 4-No. 10 3 Per Cent	Washed Sand 58 Per Cent	Sand C 100-200 1 Per Cent	Sand C Min. 200 4 Per Cent	Clay 22 P.I. 6 Per Cent
Pass. 1 in. Ret. on No. 4	100	28	28	....	....	....	....	....
Pass. No. 4 Ret. on No. 10	72	17	....	3	14	....	....	....
Pass. No. 10 Ret. on No. 40	55	35	....	....	35	....	....	....
Pass. No. 40 Ret. on No. 100	20	8	....	....	8	....	....	....
Pass. No. 100 Ret. on No. 200	12	2	....	....	1	1	....	....
Pass. No. 200	10	10	....	....	....	....	4	6

TABLE VI

Limiting minimum of coarse aggregate to No. 10, then to limiting maximum of fines below No. 40

	Per Cent	Per Cent	Coarse 28 Per Cent	No. 4-No. 10 10 Per Cent	Washed Sand 33 Per Cent	Sand E 5 Per Cent	Sand C 100-200 3 Per Cent	Sand C Min. 200 10 Per Cent	Clay 22 P.I. 11 Per Cent
Pass. 1 in. Ret. on No. 4	100	28	28	....	....	....	....	....	....
Pass. No. 4 Ret. on No. 10	72	17	....	10	7	....	....	....	....
Pass. No. 10 Ret. on No. 40	55	20	....	....	20	....	....	....	....
Pass. No. 40 Ret. on No. 100	35	10	....	....	5	5	....	....	....
Pass. No. 100 Ret. on No. 200	25	5	....	....	1	....	3	....	1
Pass. No. 200	20	20	....	....	....	....	....	10	10

Admixtures.—The general types of soil stabilization are defined in terms of function of admixtures as follows:

a) Mechanical stabilization, in which stability is provided by the equilibrium between frictional and cohesive materials without the use of any admixture. The soil-aggregate mixture containing no "stabilizer" is designed as "control."

b) Chemical stabilization, which includes the treatment of soil-aggregate with water-soluble salts or products, such as calcium and sodium chlorides, lignin binder (waste sulphite liquor), to increase the density or to produce a chemical reaction with the soil.

c) Cementation stabilization, in which a hydrating material capable of developing setting properties, such as Portland cement, is incorporated with soil aggregate.

d) Waterproofing stabilization, which includes incorporation of water-insoluble binders, such as bituminous materials, with soil-aggregate.

Our investigation included representative examples of these four types of stabilization.

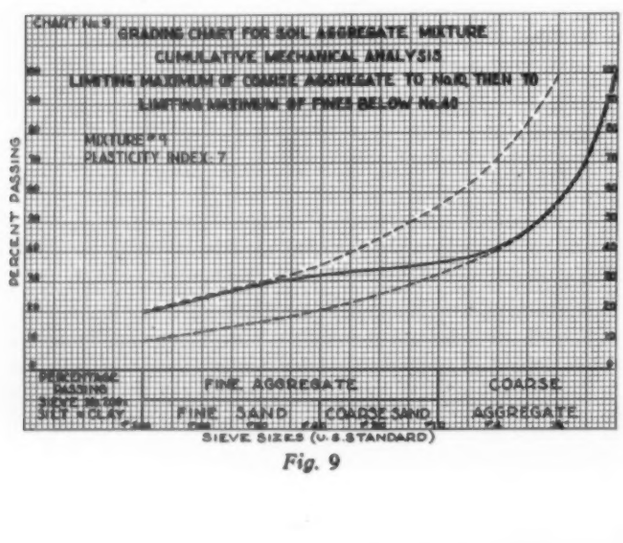


Fig. 9

TABLE VII

Limiting maximum of coarse aggregate to No. 10, then to medial grading of fines below No. 40

	Per Cent	Per Cent	Coarse 60 Per Cent	No. 4-No. 10 6 Per Cent	Washed Sand 7 Per Cent	Sand E 8 Per Cent	Sand C 10 Per Cent	Clay 22 P.I. 9 Per Cent
Pass. 1 in. Ret. on No. 4	100	60	60	....	....	....	....	....
Pass. No. 4 Ret. on No. 10	40	8	....	6	2	....	....	....
Pass. No. 10 Ret. on No. 40	32	5	....	....	4	1	....	....
Pass. No. 40 Ret. on No. 100	27	8	....	....	1	7	....	....
Pass. No. 100 Ret. on No. 200	19	4	....	....	....	....	4	....
Pass. No. 200	15	15	....	....	....	....	6	9

TABLE VIII

Limiting maximum of coarse aggregate to No. 10, then to limiting minimum of fines below No. 40

	Per Cent	Per Cent	Coarse 60 Per Cent	No. 4-No. 10 3 Per Cent	Washed Sand 20 Per Cent	Sand E 4 Per Cent	Sand C 7 Per Cent	Clay 22 P.I. 6 Per Cent
Pass. 1 in. Ret. on No. 4	100	60	60	....	....	....	....	....
Pass. No. 4 Ret. on No. 10	40	8	....	3	5	....	....	....
Pass. No. 10 Ret. on No. 40	32	12	....	....	12	....	....	....
Pass. No. 40 Ret. on No. 100	20	7	....	....	3	4	....	....
Pass. No. 100 Ret. on No. 200	13	3	....	....	....	....	3	....
Pass. No. 200	10	10	....	....	....	....	4	6

The admixtures tried may be broadly divided into two general classes: (a), water-soluble binders, such as calcium and sodium chlorides, waste sulphite liquor, and

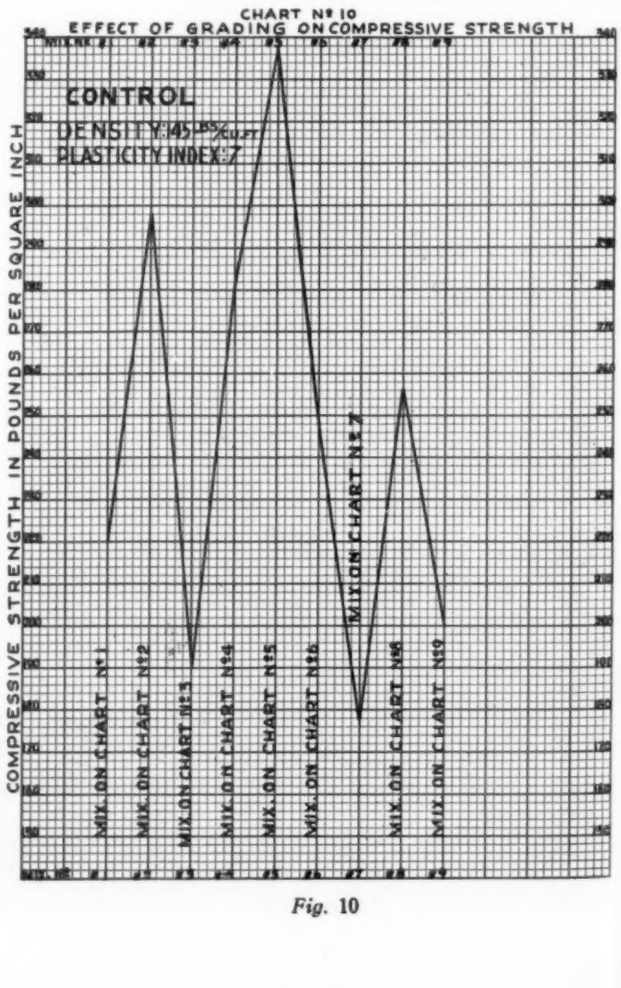


CHART No. 10
EFFECT OF GRADING ON COMPRESSIVE STRENGTH
CONTROL
DENSITY: 145 lbs/cu.ft.
PLASTICITY INDEX: 7
COMPRESSIVE STRENGTH IN POUNDS PER SQUARE INCH
MIX ON CHART No. 1
MIX ON CHART No. 2
MIX ON CHART No. 3
MIX ON CHART No. 4
MIX ON CHART No. 5
MIX ON CHART No. 6
MIX ON CHART No. 7
MIX ON CHART No. 8
MIX ON CHART No. 9

Fig. 10

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TABLE IX

Limiting maximum of coarse aggregate to No. 10, then to limiting maximum of fines below No. 40

	Per Cent	Per Cent	Coarse 60 Per Cent	No. 4-No. 10 4 Per Cent	Washed Sand 5 Per Cent	Sand E 6 Per Cent	Sand C 100-200 5 Per Cent	Sand C Min. 200 10 Per Cent	Clay 22 P.I. 10 Per Cent
Pass. 1 in. Ret. on No. 4	100	60	60	....	....	....	....	....	....
Pass. No. 4 Ret. on No. 10	40	5	....	4	1	....	....	....	....
Pass. No. 10 Ret. on No. 40	35	4	....	....	3	1	....	....	....
Pass. No. 40 Ret. on No. 100	31	6	....	....	1	5	....	....	....
Pass. No. 100 Ret. on No. 200	25	5	....	....	....	....	5	....	....
Pass. No. 200	20	20	....	....	....	....	....	10	10

(b), water-insoluble binders, such as gypsum, Portland cement, M.C.-1, R.C.-1 and R.C.-2 cut-back asphalts, R.T.-1, R.T.-2 and R.T.-3 tars, and emulsified asphalt (Bitumuls stabilizer).

Preparation of Test Specimens.—Throughout the investigation, specimens were prepared with a density of 145 pounds per cubic foot and a moisture content varying between 6.5 and 7.5 per cent, according to the percentages of fines in the mixtures.

Mixing.—Before mixing, the aggregates were air-dried and their moisture content was computed before designing the mixtures. A batch consisted of enough material to mold three identical specimens weighing 28.5 pounds each, when dry, for the compressive strength test and two other specimens weighing 14.3 pounds each, when dry, for the capillary water absorption test. The moisture content and the per cent of admixture were computed as percentage of the weight of the dry mix.

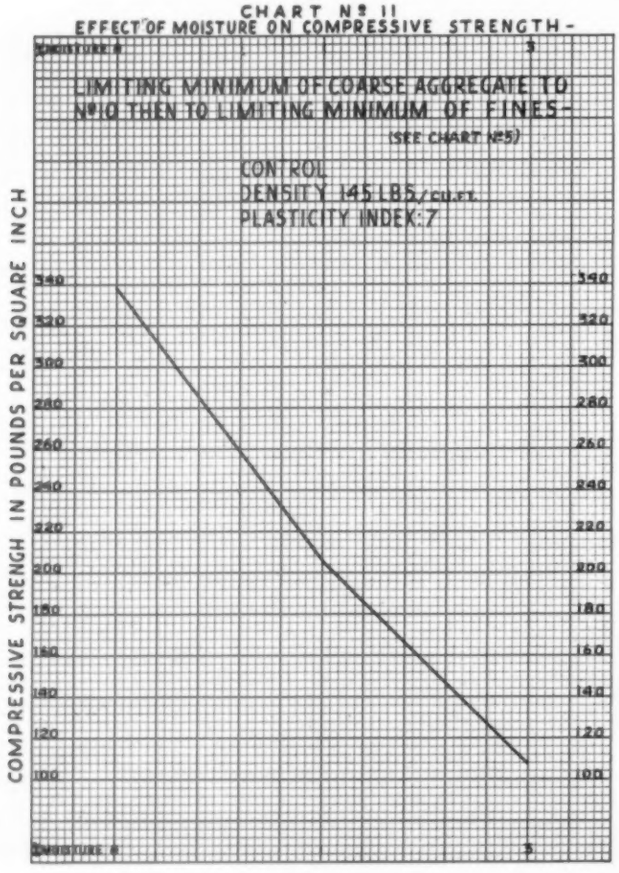
CHART Nº 11
EFFECT OF MOISTURE ON COMPRESSIVE STRENGTH
LIMITING MINIMUM OF COARSE AGGREGATE TO Nº10 THEN TO LIMITING MINIMUM OF FINES
(SEE CHART Nº5)
CONTROL
DENSITY 145 LBS/cu.ft.
PLASTICITY INDEX: 7
COMPRESSIVE STRENGH IN POUNDS PER SQUARE INCH
MOISTURE %

Fig. 11

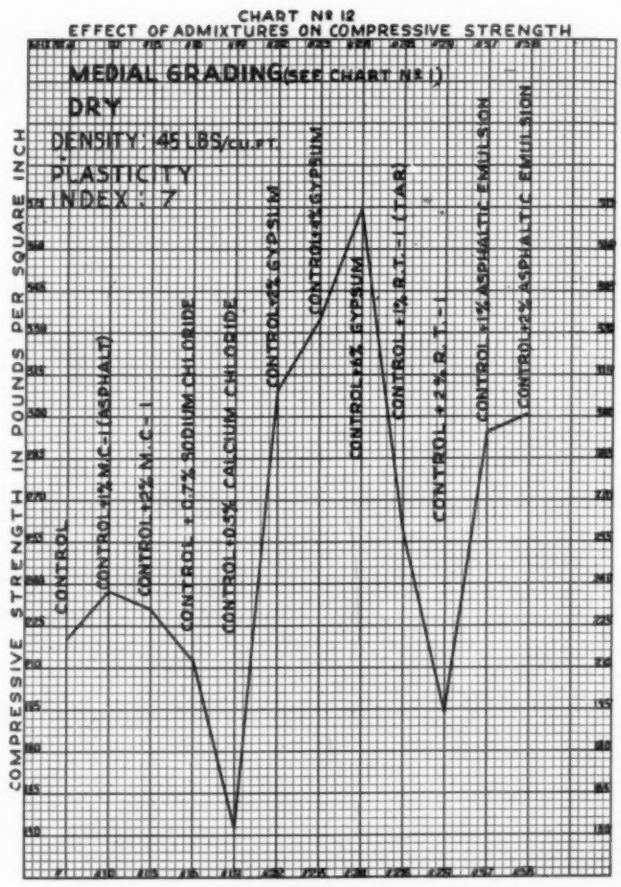
CHART Nº 12
EFFECT OF ADMIXTURES ON COMPRESSIVE STRENGTH
MEDIAL GRADING (SEE CHART Nº 1)
DRY
DENSITY: 145 LBS/cu.ft.
PLASTICITY INDEX: 7
COMPRESSIVE STRENGTH IN POUNDS PER SQUARE INCH
CONTROL
CONTROL + 1/2% M.C.-1 (ASPHALT)
CONTROL + 2% N.C.-1
CONTROL + 0.7% SODIUM CHLORIDE
CONTROL + 0.5% CALCIUM CHLORIDE
CONTROL + 2% GYPSUM
CONTROL + 2% GYPSUM
CONTROL + 1/2% R.T.-1 (TAR)
CONTROL + 2% R.T.-1
CONTROL + 1% ASPHALTIC EMULSION
CONTROL + 2% ASPHALTIC EMULSION

Fig. 12

The method of combining the soil-aggregate with the stabilizer and water depended upon the type of admixture: Portland cement and gypsum were mixed with the dry soil-aggregate before the addition of water; the bituminous materials were added after the water had been completely mixed with the soil materials; the calcium chloride, sodium chloride and lignin binder were dissolved in the water before they were admixed. All the ingredients were thoroughly mixed by hand to insure uniform distribution.

Molding.—The mixtures were compacted within wax liners in four equal layers by means of a five and one-half pound rammer with a two-inch tamping face and finally under a hydraulic press until the plunger used reached a definite level corresponding to the volume required. The three large molding steel cylinders used for the compressive strength test were 14 inches in height by 6 inches in diameter, while the two small ones for determining the resistance to water absorption were only 8 inches in height by 6 inches in diameter.

Testing Procedures—Compressive Strength Test.—The compressive strength in pounds per square inch was determined by means of a 100 ton hydraulic press on specimens dried thoroughly or to 1, 2 or 3 per cent moisture content.

To get thoroughly dry samples, the soil-aggregate cylinders were taken off the moulds and allowed to stand within the wax liner seven days; the liner was then removed and specimens were dried to constant weight in an oven at 140°F, after which they were allowed to cool in a dry place and tested.

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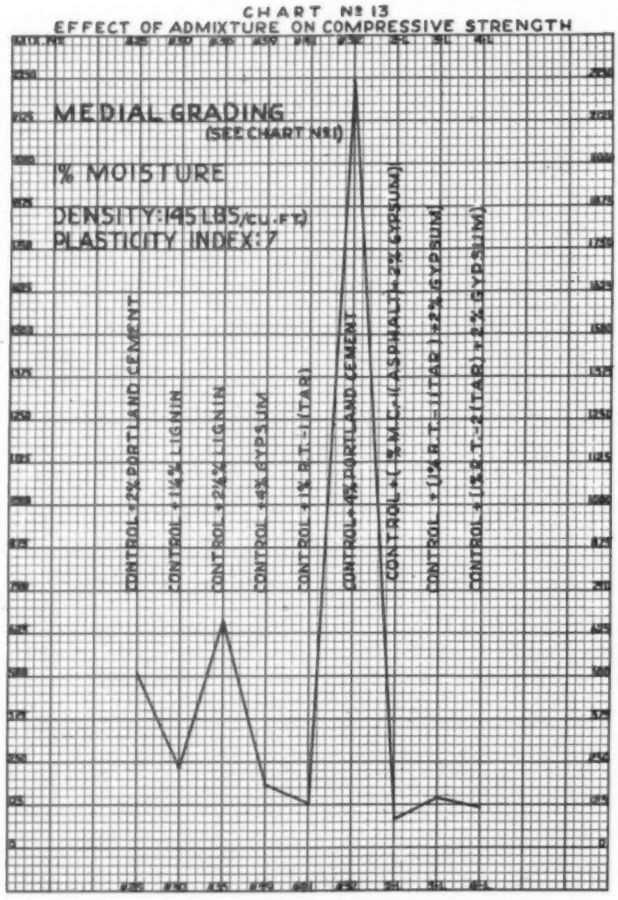
CHART Nº 13
EFFECT OF ADMIXTURE ON COMPRESSIVE STRENGTH
MEDIAL GRADING
(SEE CHART Nº1)
% MOISTURE
DENSITY: 145 LBS/cu. ft.
PLASTICITY INDEX: 7
CONTROL + 2% PORTLAND CEMENT
CONTROL + 1½% LIGNIN
CONTROL + 2½% LIGNIN
CONTROL + 2% GYPSUM
CONTROL + 1% R.T.-1 (TAR)
CONTROL + 4% PORTLAND CEMENT
CONTROL + (1½% M.C.-1 (ASPHALT) + 2% GYPSUM)
CONTROL + (1½% R.T.-1 (TAR) + 2% GYPSUM)
CONTROL + (1½% R.T.-2 (TAR) + 2½% GYPSUM)

Fig. 13

To get samples dried to 1, 2 or 3 per cent moisture content, the cylinders were allowed to stand within the wax liner on their top and bottom alternate days so that moisture was lost as uniformly as possible and that the same moisture content might be preserved throughout. When the moisture content required was reached, as indicated from repeated weighings, the three large specimens were capped with sulphur and tested.

Resistance to Capillary Water Absorption Test.—The small soil-aggregate cylinders, after being thoroughly dried as previously shown, were coated with paraffin wax except at the bottom where a blotting paper was fixed and kept in place by means of cheese cloth sticking on the sides of the specimens; a few needle holes were made on the top of the samples to allow air to escape. The specimens were immersed into water at room temperature to a depth of one-quarter of an inch and weighed after 1, 2, 3, 5, 7, 10, 14, 21 days and until they were saturated as indicated by constant weights.

Collection of Data.—A complete record of all details of procedure and test data that might in any way enter into the interpretation and correlation of results was kept for each specimen. Special attention was paid to the easiness of compaction and to the swelling of soil-aggregate cylinders after soaking into water.

Presentation of Assembled Data.—The large mass of test data accumulated in this investigation has been assembled in the forms of charts, tables and curves as an aid to interpreting and correlating it and drawing conclusions. It is felt that these charts, tables and curves are, for the most part, self-explanatory and that a discussion of all of their details is unnecessary. The discussion that follows is for the purpose of calling attention to significant trends in the data as they relate to the items of the investigation as outlined in the beginning of the paper.

The vital test data for all specimens are summarized in tabular and graphical form as follows:

The effect of grading on compressive strength and water absorption of the dry control mix is shown on Figures 10 and 17 and Table X.

TABLE X

Grading	Compressive Strength Lb. Per Sq. In.	Total Water Absorption, Per Cent,
Ideal or Medial	220	5.00
Medial to No. 10 then to limiting minimum of fines below No. 40	298	4.45
Medial to No. 10 then to limiting maximum of fines below No. 40	191	5.65
Limiting minimum of coarse to No. 10, then to medial grading for fines below No. 40	281	5.00
Limiting minimum of coarse to No. 10 then to limiting minimum of fines below No. 40	338	4.80
Limiting minimum of coarse to No. 10 then to limiting maximum of fines below No. 40	248	5.40
Limiting maximum of coarse to No. 10 then to medial grading for fines below No. 40	176	4.95
Limiting maximum of coarse aggregate to No. 10 then to limiting minimum of fines below No. 40	256	4.20
Limiting maximum of coarse to No. 10 then to limiting maximum of fines below No. 40	200	5.55

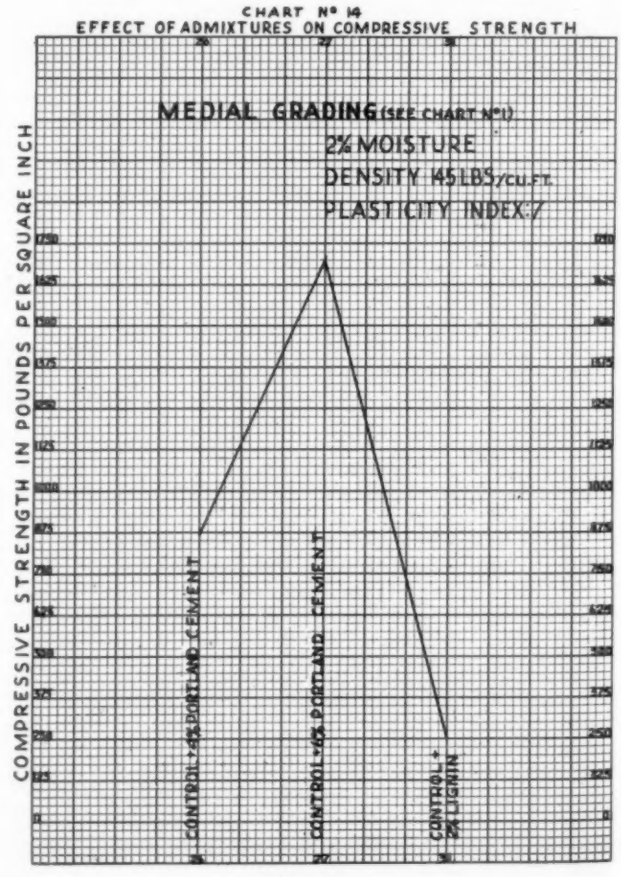
CHART Nº 14
EFFECT OF ADMIXTURES ON COMPRESSIVE STRENGTH
MEDIAL GRADING (SEE CHART Nº1)
2% MOISTURE
DENSITY 145 LBS/cu. ft.
PLASTICITY INDEX: 7
COMPRESSIVE STRENGTH IN POUNDS PER SQUARE INCH
CONTROL + 2% PORTLAND CEMENT
CONTROL + 4% PORTLAND CEMENT
CONTROL + 2% LIGNIN

Fig. 14

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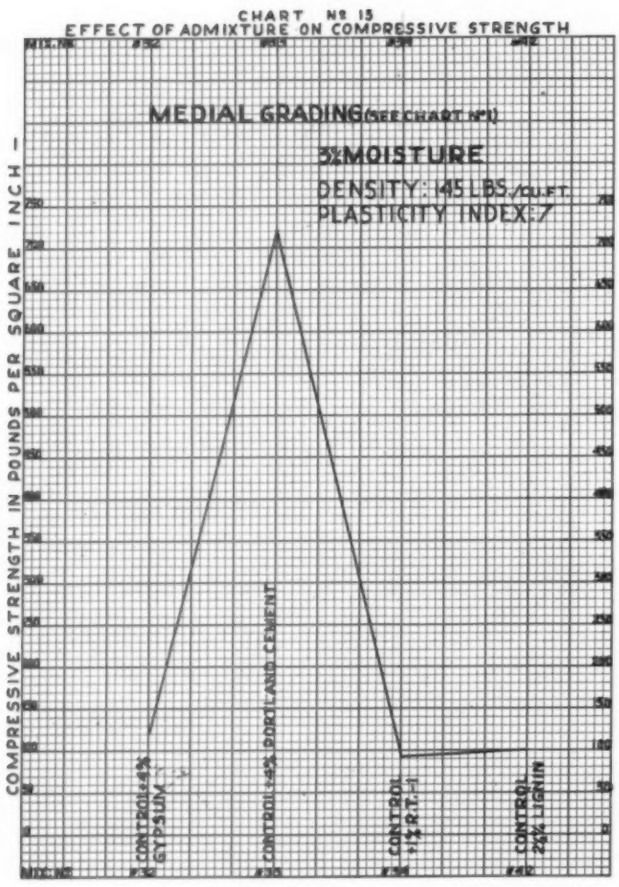
CHART Nº 15
EFFECT OF ADMIXTURE ON COMPRESSIVE STRENGTH
MEDIAL GRADING (SEE CHART Nº1)
3% MOISTURE
DENSITY: 145 LBS./CU.FT.
PLASTICITY INDEX: 7
COMPRESSIVE STRENGTH IN POUNDS PER SQUARE INCH
CONTROL + 4% GYPSUM
CONTROL + 4% PORTLAND CEMENT
CONTROL + ½ R.T.-1
CONTROL + 2% LIGNIN

Fig. 15

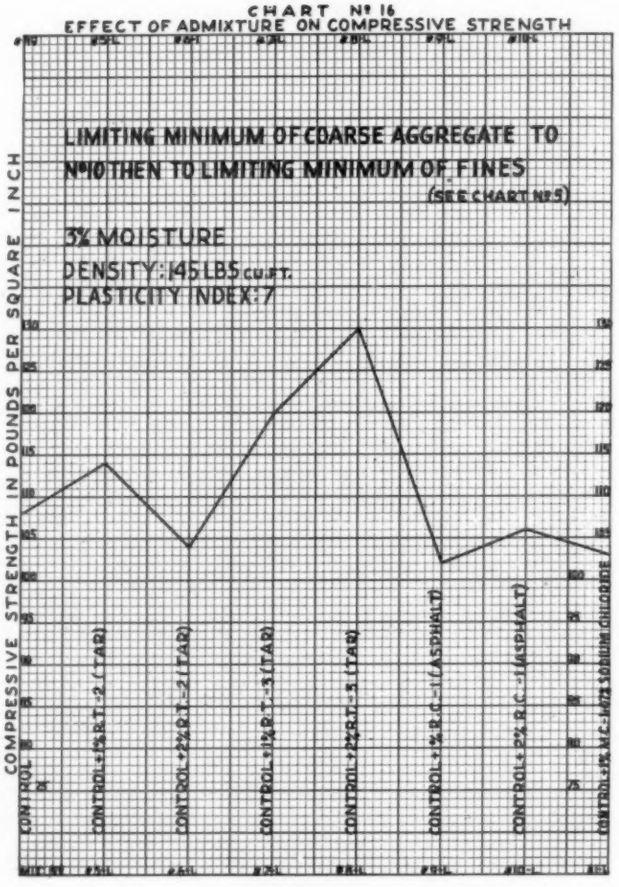
CHART Nº 16
EFFECT OF ADMIXTURE ON COMPRESSIVE STRENGTH
LIMITING MINIMUM OF COARSE AGGREGATE TO Nº10 THEN TO LIMITING MINIMUM OF FINES
(SEE CHART Nº9)
3% MOISTURE
DENSITY: 145 LBS CU.FT.
PLASTICITY INDEX: 7
COMPRESSIVE STRENGTH IN POUNDS PER SQUARE INCH
CONTROL
CONTROL + ½ R.T.-2 (TAR)
CONTROL + 2½ R.T.-2 (TAR)
CONTROL + 1½ R.T.-3 (TAR)
CONTROL + 2½ R.T.-5 (TAR)
CONTROL + ½ R.C.-1 (ASPHALT)
CONTROL + 2½ R.C.-1 (ASPHALT)

Fig. 16

We may draw from the aforegoing data that, other factors being equal, the grading of soil-aggregate mixtures that gives the highest compressive strength, when dry, is that corresponding to limiting minimum of coarse aggregate to No. 10, and of fines (see Figure 5) below No. 40; this finding is quite interesting and important, because the use of sand-clays meeting such a gradation may be extended advantageously, particularly wherever coarse aggregate is lacking. We may also notice that soil materials, the sieve analysis of which corresponds to a minimum of fines below No. 40 (see Figures 2, 5 and 8 and Tables II, V, and VIII), show the least capillary water absorption.

1. The effect of moisture content on compressive strength of the control mix, provided with a grading corresponding to minimum of coarse aggregate to No. 10 sieve and fines below No. 40 sieve (see Figure 5 and Table V), appears in in Figure 11 and Table XI.

TABLE XI

Percentage of Moisture	Compressive Strength Lb. Per Sq. In.
0	338
1	205
3	108

It is therefore quite obvious that the high compressive strength of a mechanically stabilized base course material, when dry, drops quite rapidly as its moisture content increases, which implies the necessity of waterproofing the soil base course mixtures if their dry strength is to be kept.

2. The effect of admixtures on compressive strength is shown at different moisture contents (0, 1, 2, 3) in Figures 12, 13, 14 and 15, where the gradation of the soil-aggregate is medial (see Figure 1 and Table I) and at 3 per cent moisture content on figure 16, where the grading of soil materials corresponds to limiting minimum of coarse aggregate to No. 10 sieve and of fines below No. 40 sieve (see Figure 5 and Table V).

The effect of admixtures on total capillary water absorption appears in Figures 18, 19, 20 and 21.

The effect of admixtures on the rate of total capillary water absorption is shown in Figure 22.

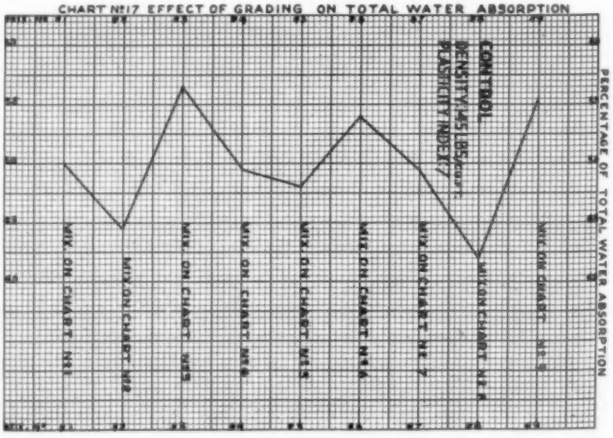
CHART Nº17 EFFECT OF GRADING ON TOTAL WATER ABSORPTION
CONTROL
DENSITY: 145 LBS/CU.FT.
PLASTICITY INDEX: 7
PERCENTAGE OF TOTAL WATER ABSORPTION
MIX ON CHART Nº1
MIX ON CHART Nº2
MIX ON CHART Nº3
MIX ON CHART Nº4
MIX ON CHART Nº5
MIX ON CHART Nº6
MIX ON CHART Nº7
MIX ON CHART Nº8

Fig. 17

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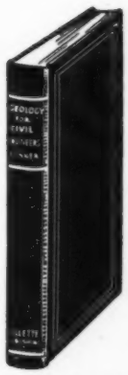

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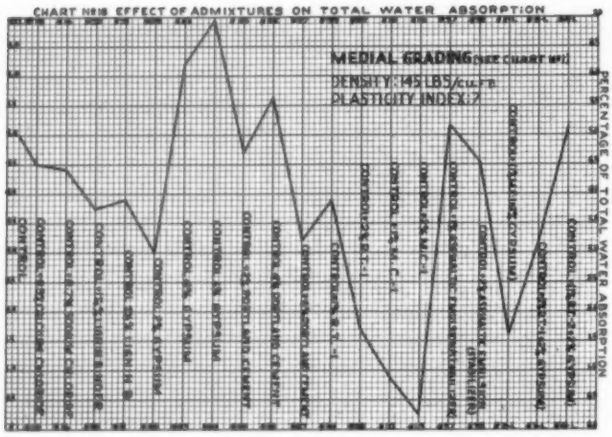


CHART N°18 EFFECT OF ADMIXTURES ON TOTAL WATER ABSORPTION
MEDIAL GRADING
DENSITY 145 LBS/cu.ft.
PLASTICITY INDEX 7
PERCENTAGE OF TOTAL WATER ABSORPTION

Fig. 18

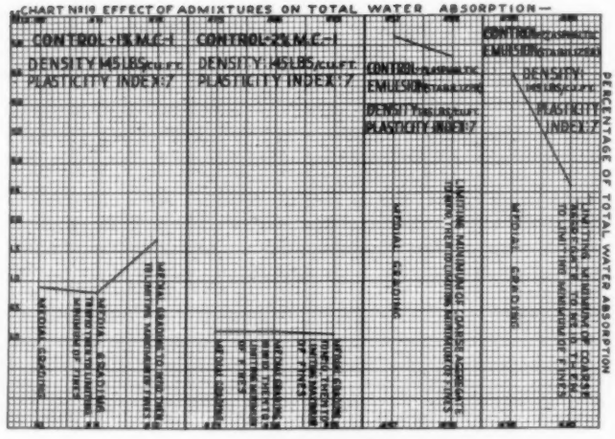


CHART N°19 EFFECT OF ADMIXTURES ON TOTAL WATER ABSORPTION
CONTROL + 1% M.C.-1
DENSITY 145 LBS/cu.ft.
PLASTICITY INDEX 7
CONTROL + 2% M.C.-1
DENSITY 145 LBS/cu.ft.
PLASTICITY INDEX 7
MEDIAL GRADING
PERCENTAGE OF TOTAL WATER ABSORPTION

Fig. 19

Water Soluble and Insoluble Admixtures

Soluble.—The effect of water-soluble admixtures on compressive strength and capillary water absorption is best seen in table XII:

TABLE XII

Per Cent and Type of Admixtures	Compressive Strength in Lb. Per Sq. In. Dry	1 Per Cent Moisture	2 Per Cent Moisture	3 Per Cent Moisture	Total Capillary Water Absorption Per Cent
0.50 Calcium chloride	152	....	....	81	4.5
0.70 Sodium chloride	213	....	....	78	4.3
1.25 Lignin binder	....	232	....	....	3.7
2.50 Lignin binder	....	640	250	100	3.8

The above data show clearly that water-soluble admixtures have no beneficient effect both on compressive strength and capillary water absorption of soil-aggregate base course mixtures. The beneficient effect of lignin binder on the compressive strength of nearly dry soil materials is rapidly lost as the moisture content increases up to 4 per cent.

Insoluble.—The effect of water-insoluble admixtures on compressive strength and capillary water absorption is shown in Tables XIII (medial grading) and XIV (grading No. 5 corresponding to limiting minimum of coarse aggregate to No. 10 and of fines below No. 40 sieve):

TABLE XIII

Per Cent and Type of Admixtures	Compressive Strength in Lb. Per Sq. In. Dry	1 Per Cent Moisture	2 Per Cent Moisture	3 Per Cent Moisture	Total Capillary Water Absorption Per Cent
2.0 Gypsum	312	....	....	....	3.00
4.0 Gypsum	336	190	....	120	6.30
6.0 Gypsum	375	....	....	....	6.80
2.0 Portland cement	....	513	....	....	4.70
4.0 Portland cement	....	2245	875	718	4.15
6.0 Portland cement	....	....	1707	....	3.20
1.0 R. T.-1 (tar)	259	122	....	93	3.60
2.0 R. T.-1 (tar)	194	....	....	....	1.70
1.0 M. C.-1 (asphalt)	237	....	....	81	0.90
2.0 M. C.-1 (asphalt	231	....	....	....	0.30
1.0 Asphaltic emulsion	295	....	....	....	5.15
2.0 Asphaltic emulsion	301	....	....	....	4.55

TABLE XIV

Per Cent and Type of Moisture	Compressive Strength in Lb. Per Sq In. 3 Per Cent Moisture Content	Total Capillary Water Absorption Per Cent
1.0 R.T.-2 (tar)	114	2.60
2.0 R.T.-2 (tar)	103	0.50
1.0 R.T.-3 (tar)	120	2.75
2.0 R.T.-3 (tar)	130	0.75
1.0 R.C.-1 (asphalt)	102	1.00
2.0 R.C.-1 (asphalt)	106	0.60

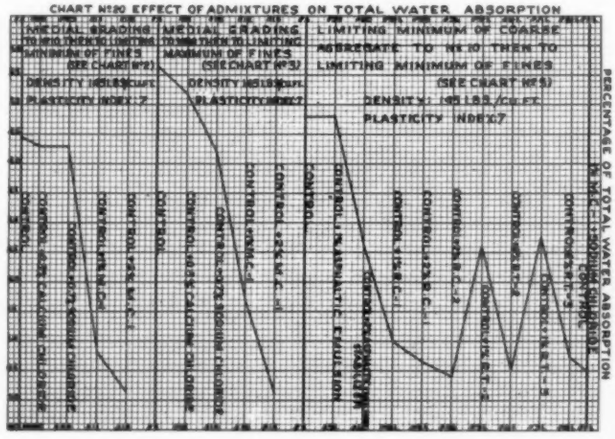


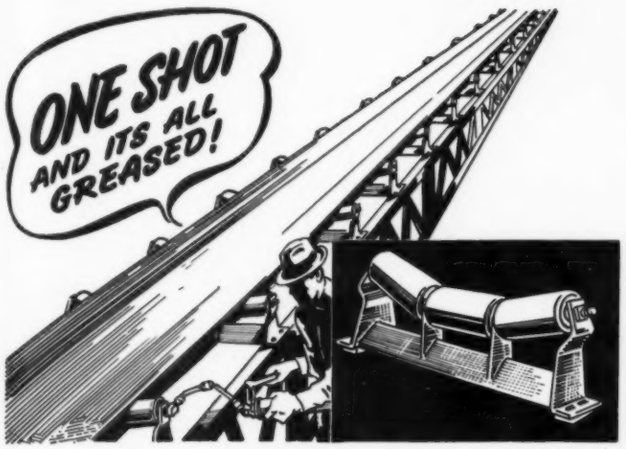
CHART N°20 EFFECT OF ADMIXTURES ON TOTAL WATER ABSORPTION
MEDIAL GRADING
DENSITY 145 LBS/cu.ft.
PLASTICITY INDEX 7
LIMITING MINIMUM OF COARSE AGGREGATE TO NO.10 THEN TO LIMITING MINIMUM OF FINES
(SEE CHART N°5)
DENSITY 145 LBS/cu.ft.
PLASTICITY INDEX 7
PERCENTAGE OF TOTAL WATER ABSORPTION

Fig. 20

It may be deduced from the aforegoing data that out of the water-insoluble binders, hydrating materials (portland cement, gypsum) are far from improving the resistance to capillary water absorption; however, portland cement increases the compressive strength of the control mix materially, at 0 per cent, 2 per cent and 3 per cent moisture contents, and proportionally to the percentage of admixtures. It is obvious that the bituminous materials which were tried lower the compressive strength of soil-aggregate mixtures slightly; however, liquid asphalts and tars cut the capillary water absorption to a large extent and proportionally to the amount of bitumen used (emulsified asphalt "stabilizer" did not show any beneficient effect on the resistance to capillary water absorption, according to the amounts used).

General Conclusions

1. The compressive strength of mechanically stabilized base course materials is satisfactory, when dry, but drops quite rapidly as their moisture content increases. Conse-



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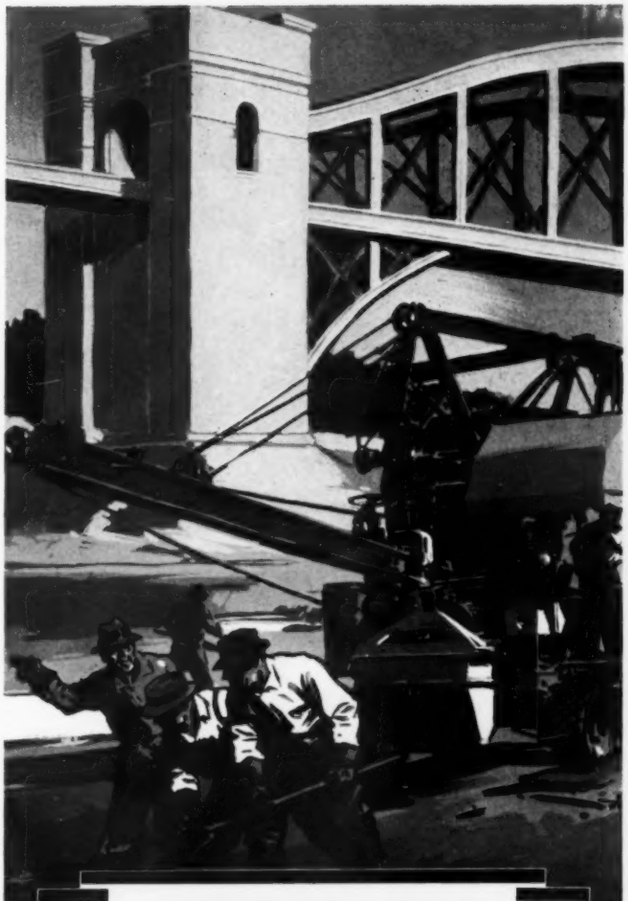

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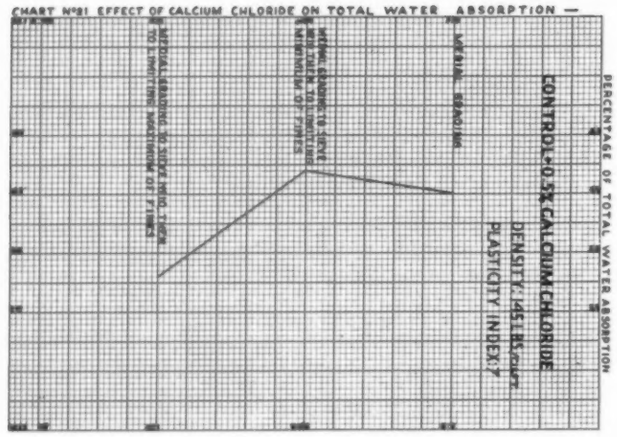
CHART N°21 EFFECT OF CALCIUM CHLORIDE ON TOTAL WATER ABSORPTION
CONTROL+0.5% CALCIUM CHLORIDE
PERCENTAGE OF TOTAL WATER ABSORPTION

Fig. 21

quently, compressive strength and capillary water absorption are two important properties affecting the stability of soil-aggregate base course mixtures.

2. Other factors being equal, the gradation of soil materials which corresponds to limiting minimum of coarse aggregate to No. 10, and of fines below No. 40, provides the highest dry compressive strength.

3. Other factors being equal, the soil-aggregate mixtures the sieve analysis of which corresponds to limiting minimum of fines below No. 40 sieve show the least capillary water absorption.

4. Water soluble admixtures provide no advantages to soil-aggregates for base course from the standpoints of compressive strength and capillary water absorption. However, they may ease the compaction and lower the freezing point of water absorbed.

5. Water-insoluble admixtures behave differently towards soil-aggregate base course mixtures: (a) hydrating materials show no benefit from the viewpoint of resistance to capillary water absorption, while portland cement gives the control-mix a definite improvement in compressive strength at any moisture content and proportionally to the amount used; (b) bituminous materials render the soil mixtures resistant to water from capillarity and enable them to retain under field conditions a satisfactory bearing capacity in comparison with what they have when in a dry, compacted condition.

6. As, other factors being equal, the shearing resistance (which is a measure of stability and is an important factor to consider when computing the thickness of a base course according to the Housel formula) of a waterproofed mechanically stabilized base course is several times higher in its most severe field conditions (3 per cent moisture content) than that of a mechanically stabilized one during the thawing period (4 to 6 per cent moisture content), the first type of base course is unquestionably superior in strength and stability to the second one, even if the latter is thicker by several inches.

7. The valuable information obtained from the investigational work provides an interesting field for further research.

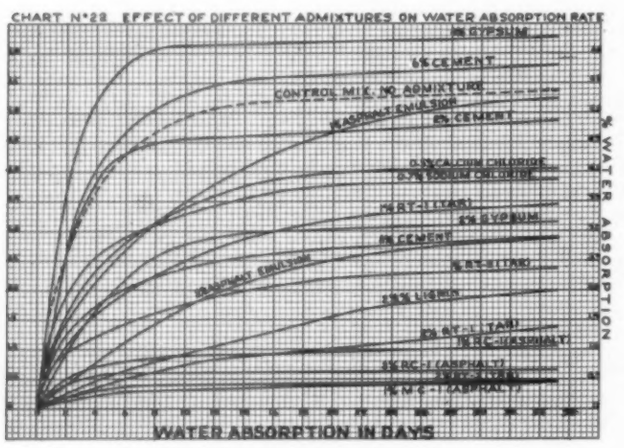

Fig. 22

NEW EQUIPMENT FOR EVALUATING ROAD SURFACE ROUGHNESS

A new piece of standardizable equipment for measuring highway surface roughness that operates on the principle of the measurement of the vertical oscillation of a wheel suspension with respect to its supported frame was described by J. A. Buchanan and A. L. Catudal of the Public Roads Administration in a paper presented at the recent 20th annual meeting of the Highway Research Board.

The new equipment is in the form of a single wheel semi-trailer, attachable to any towing vehicle, and is designed as a horizontal pendulum with the axle of the wheel placed at the center of percussion. The gross weight of the entire vehicle is 740 lb. A special feature of the equipment is the incorporation of a newly-designed overrunning clutch integrator whose operating characteristics are remarkably constant. All connections to the instrument board in the towing vehicle are made electrically.

Many hundred miles of operation, without mechanical failure, indicate adequate mechanical design. It is easy to use and the data are obtained rapidly with it.

It is believed that the underlying principle as a means for indicating the relative roughness of road surface is sound and that the present equipment is superior to that developed earlier in two important respects: first, the introduction of a special vehicle has removed the uncertainties of vehicle operation that were always present when an automobile was a component part of the measuring apparatus; and second, the entire equipment is so designed that it can be exactly duplicated and, to this extent, the equipment is standardizable.

HIGHWAY WEED ERADICATION IN CALIFORNIA

The California Division of Highways spent $102,000 in 1939 to control weeds and other vegetation along the State highways. This figure includes the cost of equipment and the labor of highway crews in eradication operations which many times result in a restriction of traffic. When weeds are being burned along the ditches and fence line of the highway, the equipment necessarily occupies almost half of the road and the smoke makes visibility difficult for drivers. During these operations, flagmen are stationed at the point where the operations are under way to control and otherwise assist traffic to safely pass.

Opens Engineering Office.—Alex F. Sachs, formerly highway engineer of Jackson County, Missouri, and J. E. Schnittger, formerly chief engineer, have opened offices at 706 Land Bank Bldg., 15 West 10th St., Kansas City, Mo. They will specialize in the construction and maintenance of roads and streets.

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Division of Construction,
U. S. Public Roads Administration

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M. Am. Soc. C. E.

and

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By George E. Goodwin, C.E.

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CONTENTS

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The text has been compiled with a view to its utility not only to the practicing engineer, but to the undergraduate student in highway and civil engineering as well. It is the author's thought that such a volume should be assigned to the student prior to or, at least, simultaneously with his embarkation upon the study of structural design proper.

The tables of quantities and costs should prove of great benefit to the engineer in the field who is engaged in highway location or relocation, to highway maintenance engineering organizations, and to field parties, divisional organizations, municipal and county engineers, and others engaged in the construction, location, or design of highway bridges.

CONTENTS

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Readers' Comments

To the editor:

Your November editorial on brick pavement fillers arouses my interest, as a number of brick pavement contracts were undertaken by the New York State Highway Department in 1941 and 1915 and Portland cement grout was used to fill the points in the brick.

Sections of this pavement are still in use on the New York and Albany Post Road in Ossining and Poughkeepsie, and while some minor blow-ups have been experienced, as well as surface depressions due to settlement over utility installations, the brick has proved so durable and of such a satisfactory surface texture, that I, like you, have never understood why asphalt fillers were adopted as a standard.

J. S. Bixby
State of New York
Dept. of Public Works

To the Editor:

In reply to your editorial in the November issue of Roads and Streets, I will attempt to clarify your rather vague knowledge of vitrified brick pavement filler history and acquaint you with the development of the "Modern Brick Pavement." (See enclosed article.)

Your first statement advises that prior to 1917 sand only was used as a filler. (This was admittedly only a recollection—Ed.) Our records show that cement-grout filled brick pavements were constructed in the early part of 1900 and that tar, tar-mastic, and bituminous fillers were specified and used during the period from 1905 to 1915. In 1911, 1912 and 1913, the Connecticut Avenue experimental road in Washington, D. C., was constructed by the Bureau of Public Roads. On the brick section, a cement-grout filler was used. (See Public Roads Journal, Volume 9, No. 3, May, 1928.) Many miles of excellent cement-grout filled brick pavements have been built and have served traffic needs of the day for a period of from 30-45 years.

With the advent of interstate truck and bus traffic and an increase in the volume of traffic, it was necessary to provide a more resilient two-course brick pavement. An asphalt filled brick course lends itself well to neat and easy removal and replacement necessitated in small areas by service cuts and minor repairs. Many of the cement-grout filled brick pavements, which had no provision for expansion and contraction, developed irregular longitudinal cracks, usually near the center line of the road. There were also numerous blow-ups for the same reason. The rigidity of a cement grouted brick course is a disadvantage in a two course pavement because the "bridging strength" of the brick course alone is not sufficient to support present day traffic and the brick course is not in such perfect contact with the base that it adds its strength to the strength of the base.

Asphalt filler was first used prominently in the Middle West, particularly in Illinois. The paving brick industry more or less adopted asphalt filler as standard practice around 1920-1922. The squeegee method of application was used and left a film of asphalt on the brick surface, which had to be worn off by traffic. This condition, together with the fact that mostly smooth surface bricks were used at that time, accounted for a certain amount of slipperiness in wet weather.

The manufacture of vertical fiber lug brick with a wire cut surface and the adoption of the "removal method" of excess asphalt filler material by the use of a separating agent has practically eliminated this slippery condition.

Your list of the inadequacies of asphalt filler does not apply to the modern recommended asphalts. The Research Bureau of the National Paving Brick Association has devoted much time and study to experiments with asphalt fillers in order to determine the most suitable type and specifications. (See R. R. Litehiser's and H. Z. Schofield's Report to the Highway Research Board, November 1936, on the Filler Test Road in Ohio, attached.)

The "Modern Brick Pavement" of two-course design and construction is particularly noted for its highly non-skid qualities, and for your further investigation and observation, I refer you to the following brick pavement projects where exuding of asphalt filler is at a minimum. In these pavements, unlike ivory soap, the bricks *do not float* in an asphalt bath during the excessive summer heat.

New York City—Lincoln and Queens Midtown Tunnels, streets in the vicinity of the Jamaica Courthouse, Boro of Queens.

Philadelphia—Chestnut Street, Walnut Street, 12th Street, and Washington Lane.

Baltimore—Howard Street Bridge and Underpass, Chase Street, Highland Avenue, 29th Street Bridge, Saratoga Street, Monument Street.

All of these projects are constructed of vertical fiber lug, wire cut surface brick, on mastic cushion, with asphalt filler of pure asphaltic base. This is the preferable design for two-course brick pavements.

In regard to your final statement—"Cement-grout filler has merit in creating pavement strength with brick, which has not been given due consideration." I refer you to the "Vibrated Monolithic" type for road construction as developed in Ohio in 1938. This type is a revival of the monolithic roads built by Alan J. Parrish in 1915 and 1916, referred to in your editorial, but modernized by the use of mechanical vibratory equipment to obtain a smoother and truer cross-section and road surface. The new type also provides for volume change and crack control by the installation of joints in the brick surface course. That this type is not being overlooked and is proving satisfactory for highways is evidenced by the fact that last year (1940) the Ohio Department of Highways awarded three more contracts, totalling approximately 7 miles.

The National Paving Brick Association, representing the paving brick industry, welcomes constructive criticism and will gladly furnish you with any detailed data or information you may desire.

W. H. Cullimore
Engineer-Secretary
National Paving Brick Association

WORLD'S HIGHEST DOUBLE DECK SPAN

The Pitt River Bridge, now under construction in the Central Valley Project of the U. S. Bureau of Reclamation, will be the highest double-deck span in the world. The bridge will be the closing link in the Southern Pacific R. R. and highway relocations around the Shasta Reservoir site. The upper deck of the bridge which will be 500 ft. above the present level of the Pitt River will carry four lanes of U. S. Highway 99. The lower deck will carry two tracks of the Southern Pacific's main line between San Francisco and Portland, Ore.

EDITORIAL

ENGINEERING EDUCATION

AN EASTERN engineer, the writer understands, made a statement to the effect that engineering students are not well enough educated when they graduate. It was claimed that a longer college course would be required to produce men more valuable to the engineering profession.

Some engineers argue that certain men never will become successful engineers no matter how much schooling they get. These men, they state, should be weeded out of engineering schools in the first years of their college work. Others argue that the profession is getting too crowded and that students should be weeded out before their chances are lost for making successful strides in some other field of endeavor. Following is a statement by Mr. James D. Anderson before a chapter meeting of the A.S.C.E. at Casper, Wyoming, on Feb. 27, 1941, which illustrates this point of view:

"Any lengthening of the prescribed engineering courses from four to five or six years would not benefit either the vast majority of engineering students or the engineering profession as a whole.

This extension in years of training would admittedly give the graduate a broader background upon which to base his engineering career, but at what cost to the individual? Four years in college cannot and do not make engineers out of some of the individuals who aspire to the profession. Nor would five, six, or even eight years of schooling do any more toward making them engineers. Why use any more than four years of their lives and the time of their instructors, to say nothing of the individual and public expense, in the case of tax supported institutions, before putting these boys into the field where they can realize the mistake they have made and change to other fields in which their success is more assured?"

Then there are those who argue that young men should be allowed to progress as rapidly as their abilities permit. They assert that these men are bound to become successful and should be given the opportunity to take more advanced work, and perhaps more years of specialized work. Naturally, involved in this whole picture is the fact that our publicly owned higher educational institutions are the property of a democracy and under our system of democracy everyone who aspires to a degree in an institution of higher education shall be given equal opportunity to do so. So long as we support this principle of equality under government, and the writer hopes it will be forever, the less capable or less apt student must be given equal opportunity with his more mentally alert class-mate, even is it is to his own detriment and even though he may never become an engineer.

From the economic point of view the writer believes it is certainly inadvisable to require a longer period of study at college in order to obtain a degree in engineering. The annual income of engineers as a group is pitiably low in comparison to the investment they make for an education and in comparison with the income of a small merchant, even. Another reason it is inadvisable is that it would tend to reduce the percentage of students who complete the course. Those who leave before the courses are complete are frequently psychologically handicapped, in that they harbor an attitude of futility which is evidenced in their work.

One of the principle criticisms of the four year course, at the present time, is that it fails to give the engineering graduate a satisfactory background in the social sciences, in economics, and in the humanities. It is granted that a grounding or an acquaintanceship in these subjects would be a desirable accomplishment for those who can afford it, but many cannot. The average engineer will seldom, if ever, have the opportunity to apply such training in his work. The economics and social aspects of an engineering project does not lie within the field of activity of the new graduate. It lies, rather, within the scope of activity of the engineer whose years of experience have enabled him to acquire this knowledge since completing his formal college training. Engineering graduates cannot hope to depend upon finding usable those theories of social economy and the humanities they might have studied in school when they reach that point in their careers ten, fifteen, or twenty years afterward, when they might have use for them. The so-called social sciences are changing. What is correct procedure today may be obsolete next year.

Engineering principles however, are fundamental, basic, natural laws. Once properly taught to a man they will guide him in all of his future work. In teaching, however, they should be exemplified, modeled, and tied into the practical work of an engineer. It is this last phase upon which more stress should be placed, in the judgment of the writer. Presentation to a student of the laws of nature, of physics, of mechanics, and of chemistry as pure statements does not register with most students. These principles, laws, and reactions must be exemplified and practical problems employing the principles should be discussed.

Often an engineer stumbles around with a problem looking for an engineering formula by which to obtain a solution, when all that is required is the exercise of a little common sense coupled with the bravery to go ahead. Too many students turn out to be men searching through engineering handbooks for some formula to solve the particular problem at hand. Had they had training in college in the application of common sense in analyzing a problem, the chances are that they would have thought out a formula of their own. Ten minutes of independent thinking is worth days of formula hunting.

Let's not exceed the four year requirement in college, but let us apply the principles of engineering to practical problems while we have an instructor to help us guide our thinking.

CALIFORNIA OWNS EQUIPMENT VALUED AT $5,858,000

The inventory value on June 30, 1940, of equipment owned by the Division of Highways of the California Department of Public Works was $5,858,431. The recently issued biennial report of the Division lists the major pieces of equipment as follows:

Motor Vehicles:	
Passenger, expresses also trucks up to 2-ton capacity	1,185
Trucks	
From 2- to 8-ton capacity	623
Shovels	
Gasoline power ½ cubic yard or less	18
Gasoline power with dragline attachment	2
Diesel powered ¾ cubic yard or less	2
Gasoline powered over 1 cubic yard	1
Diesel powered over 1 cubic yard	7
Tractors	
Wheel type, pneumatic tires	55
Tracklaying type, gasoline powered	65
Tracklaying type, Diesel powered	62
Graders	
Pull type	145
Graders—Tractor	
Gasoline power, hand control	5
Gasoline powered, power control	99
Diesel powered, power control	60
Scarifiers	43
Scarifiers—pneumatic tires	24
Air Compressors	
Gasoline powered	23
Diesel powered	9
Rock drills	86
Pump units	41
Kettles	235
Trailers, solid tires	20
Trailers, pneumatic tires	44
Mowers	21
Mowers with power units	30
Snow Plows	
Power driven rotaries	30
Blade and "V" type	159
Angledozers	68
Rollers	
Gasoline power	26
Multiple-tired, pull type	6
Scrapers, carryall and other wheeled types	36
Total	3,230

BE CAREFUL WITH THOSE BLASTING CAPS

Warnings are being broadcast by the Institute of Makers of Explosives asking all users of blasting caps to make sure that they do not fall into the hands of children. The campaign to prevent accidents of this type has been carried on continuously since 1926 by the manufacturers who comprise the Institute. Last year there was a reduction in the number of children injured—157 as compared with 195 in 1939.

The Institute of Makers of Explosives points out, however, that with the cooperation of all, these accidents could be lessened even more and perhaps entirely eliminated. It is unfortunate that nearly all of them are caused when children find caps which have been carelessly thrown away after blasting operations or have been left in or near the home where children can find them.

Statistics collected by the Institute show that children explode the caps by picking them with nails or pins, hammering them, or throwing them into fires. In the resulting accidents, the boys and girls suffer serious injuries to eyes, hands or fingers, to the face, and other parts of the body. In many cases the child is made unfit for useful work in later life. Sometimes death results.

It will be a public service if all users of explosives will make sure to eliminate carelessness in this matter and make certain that blasting caps are not left where they will fall into the hands of children.

SUCCESSFUL ANNUAL MEETING OF ASSOCIATION OF STATE HIGHWAY OFFICIALS OF THE NORTH ATLANTIC STATES

With as large an attendance as ever gathered for their annual convention, the Association of State Highway Officials of the North Atlantic States concluded a successful 3 day convention, Feb. 18 to 20, at Boston. All phases of highway problems were discussed by men who specialized in each subject. The annual banquet, entertainment, and dance was crowded to overflowing.

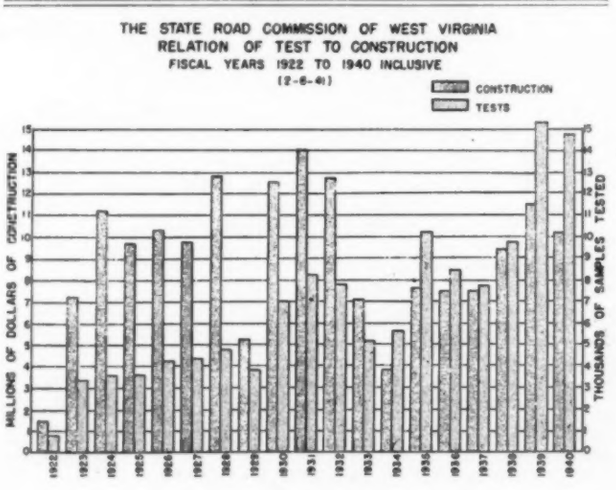
WYOMING ENGINEERING SOCIETY CONVENES

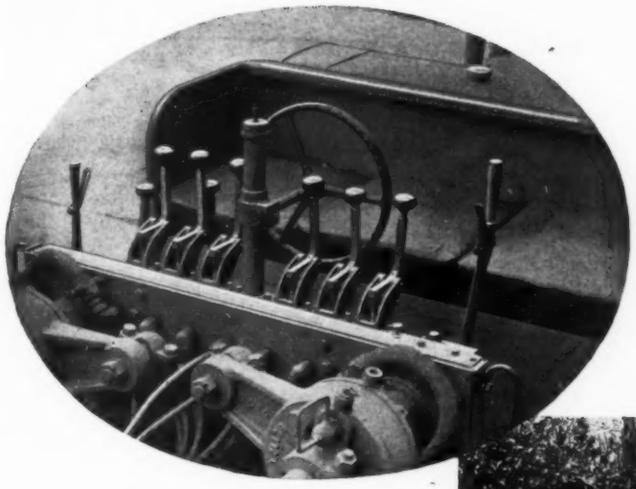
Meeting at Casper, Wyoming, for two days of annual convention, the Wyoming Engineering Society concluded their twenty-second annual meeting with an excellent, interested attendance. The scope of each of the meetings was general because engineers interested in sewage disposal, water supply, irrigation, highways, forest mapping, water power, aviation, conservation and similar subjects were present. The convention closed with a bang-up entertainment and banquet on the night of March 1, 1941.

INFORMATION ON AIRPORT ENGINEERING

A recent publication of the American Association of State Highway Officials and the Highway Research Board, 2101 Constitution Ave., Washington, D. C., entitled "Highway Research 1920-1940," lists 1335 completed and current projects of 85 different agencies. Of this number 1037 have some bearing on the engineering of airports.

Snow Removal Costs in California.—An analysis of snow removal costs in relation to traffic made by the Maintenance Engineer of the California Division of Highways in January, 1940, disclosed that the average unit cost for snow removal on the through routes and connections has been $4.06 per thousand vehicle miles of travel, and the unit cost on the purely recreational routes has been $11.02 per thousand vehicle miles.





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EASY OPERATION—INSTANT ADJUSTMENT AT TOUCH OF A LEVER—ACTION WHEN YOU WANT IT WITH GALION HYDRAULIC CONTROL—AVAILABLE ON GALION 101 and 201 Motor Graders.

ALSO full revolving circle; all-gear driven double drive; hydraulic steering; wide front axle, leaning front wheels; wide range of blade adjustment—in any position—under any condition; gasoline or diesel power. Write for bulletin.

Also road rollers in 3-wheel, tandem, portable, trench and sheepsfoot types for any compaction need; pull graders; spreaders; grader blades.

The Galion Iron Works & Mfg. Co. Galion, Ohio

LARGE YARDAGE ON LONG HAULS AT LOW COST!

If you have material to move *at long ranges*, you will profit by using a SAUERMAN Power Drag Scraper or Cableway Excavator.

These machines perform the *triple service* of digging, hauling, and dumping in one operation. Working efficiently over ranges from 100 to 1500 ft., SAUERMAN Machines will move 10 to 1000 cu. yds. per hour—actually tons for pennies, insuring maximum economy and greatest possible profit for you.

Pictured above is a mobile type of Sauerman Scraper machine used by San Bernardino County, California, for building check dams, digging reservoirs and cleaning out debris basins. The scraper hoist is mounted on a tractor and the guide blocks are suspended from a light steel head-frame which is moved along on rollers. This unit proved so satisfactory that two more were bought for use in the county's extensive public works program.

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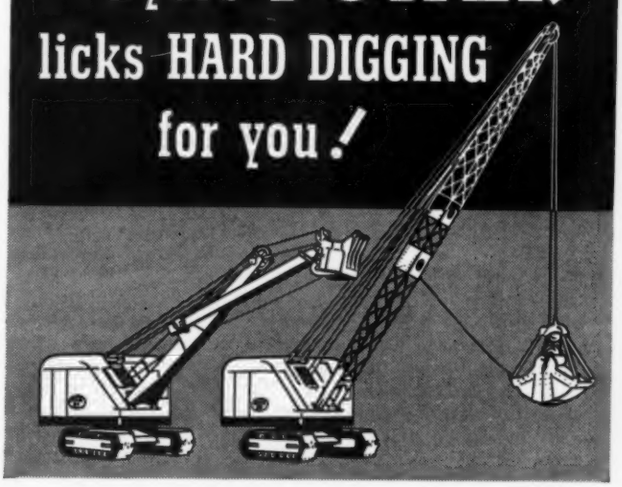
Byers POWER licks HARD DIGGING for you!



11 FULLY CONVERTIBLE MODELS IN 3/8-1/2-5/8-3/4 YD. SIZES

Modern CRANES and SHOVELS

BYERS

RAVENNA, OHIO

NEW EQUIPMENT and MATERIALS

New Road Maintainer

A new road maintainer, the No. 8—a multiple-blade machine, has been announced by the J. D. Adams Co., Indianapolis, Ind. The manufacturer states that this machine will maintain gravel, stone, and dirt roads (or shoulders) at speeds up to 15 m.p.h., leaving no windrow to endanger traffic. It may be pulled by 1½-ton or larger

The No. 8 Road Maintainer

trucks, or 45 b.h.p. pneumatic-tired tractors. Operating advantages claimed by the manufacturer are:

Automatic blade control which automatically adjusts the cutting action of the blades according to the load and resistance against the blades. This control requires no attention after once set for the results desired, thus leaving the operator free to operate the truck or tractor and at the same time assuring a smooth road surface. High-speed maintenance—made possible by the automatic load control adjustment, and the fact that the blade structure rides on skids making it free of the bounce of the pneumatic-tire-mounted main frame. Leaves no windrow—produces a finished surface in one passage of the machine, eliminating the necessity for a second trip to spread the windrow. Oversize stones can be removed—by adjusting the spreader blade to prevent the large stones from passing underneath the blades and attaching a stone thrower attachment which deposits all over-size material on the shoulders. Low investment—the No. 8 maintainer is a comparatively low-cost unit which can be pulled by trucks or tractors, and this pulling equipment can be used for other jobs. Prices and literature can be had on request addressed to J. D. Adams Company, Indianapolis, Ind.

New "Caterpillar" Rubber-Tired Industrial Tractor

A rubber-tired industrial tractor, powered by a 90 hp. diesel engine and stated to be capable of hauling more than 13 tons of earth at 18 miles an hour, has been announced by Caterpillar Tractor Co. of Peoria, Ill. "Caterpillar" has also designed and built an 11 cu. yd. heaped measure, bottom dump, pneumatic tired wagon to go with the new tractor. Hydraulic scrapers, especially designed for the machine are manufactured by the LaPlant-Choate Mfg. Co., Inc., of Cedar Rapids, Ia.; and cable controlled scrapers, by R. G. LeTourneau, Inc., of Peoria. The DW-10 tractor has been introduced after more than three years of intensive development work and field tests. It is built specifically for use on roadbuilding, construction and national defense projects, where speed, long hauls and other physical conditions are favorable to rubber tires. Powered by the D468 "Caterpillar" diesel 6-cylinder, water cooled automotive engine, the tractor weighs 14,500 lb. and has a tractive effort of 13,000 lb. in low gear, with a loaded wagon or scraper. A quick acting, vertical type governor gives fast pickup to get the loaded tractor and wagon to full speed almost immediately. The transmission is the constant mesh type, and has five forward speeds, ranging from 2.4 to 18 m.p.h.; and one reverse speed of 3 m.p.h. The "Caterpillar" W-10 wagon has 8⅛ cu. yd. struck measure capacity, and 11 cu. yd. heaped measure capacity. The body is of the hopper type. It is constructed of pressed shapes formed from plates of special alloy steel,

New Caterpillar Tractor and Wagon

and is of all welded construction to provide maximum strength. The body measures 13 ft. 2½ in. in length by 6 ft. 11 in. in width at the top; and 10 ft. by 4 ft. 9 in. at the bottom. It has a depth of 3 ft. 6 in. A rear bumper is provided on the wagon to facilitate dumping or loading operations where a pushdozer is required. It also acts as protection to the rear wagon tires. The full length bottom dump doors on the wagon are hydraulically operated from the tractor, and are designed to permit ejection of material at any desired speed, thus reducing the amount of bulldozing necessary on the fill. There are approximately 31 in. of clearance with the doors in hauling position; and 13½ in. clearance with doors open to a maximum. Rear tires on the DW-10 tractor and the W-10 wagon are the same size—18.00 x 24 16-ply. The tractor-wagon combination weighs 24,500 lb. and measures 32 ft. 8 in. in length.

New Lubricant for Heavy Duty, High Speed Engines

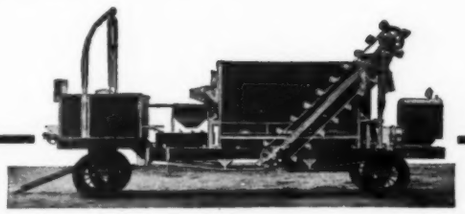
A new type of engine lubricant, Essolube HD, developed to overcome piston varnishing, ring sticking and other major lubrication troubles of heavy-duty, high-speed diesel and gasoline engines, has been announced by the Standard Oil Co. of New Jersey. This new lubricant is stated to have highly "detergent" or "washing" properties incorporated in a highly stable, high "viscosity index" base oil. The new Essolube HD has a viscosity index of approximately 100. This new lubricant, it is stated, has, in addition to inherently natural resistance to oxidation and high temperature, an exceptionally high ability to wash out sludge deposits, protect bearings from corrosion and to prevent substantially deposits of varnish on pistons, valve stems, rings and other engine parts. It also has a valuable rust preventive action. Essolube HD has been tested exhaustively in the laboratory and on the road in actual service operations. It has passed the severe General Motors diesel test and also been formally approved by the Caterpillar Tractor Co. for use in its diesel engines.

New Motor Pick-Up Sweeper

A new 2½ cu. yd. capacity, Model 50 sweeper, that sweeps a path 9 ft. wide has been brought out by the Austin-Western Road Machinery Co., Aurora, Ill. Both of the brooms and the self-cleaning, beltless elevator are independently raised and lowered by hydraulic power, simply by shifting small convenient levers within easy reach of the operator. Through an auxilliary mechanical arrangement, the brooms are made to hug pavement without "dancing," still they can rise or fall when broad, irregular surface sections are encountered. Brooms have two speeds—one for ordinary and one for hard sweeping conditions. A 4-wheel, reinforced chassis, using solid axles, gives sweeper a truck-like stability and serves to maintain a more accurate alignment of all working

Model 50 Sweeper

parts. On the Model 50, the headlights have been moved forward from the dash to the radiator, both to further improve general visibility and also to reduce shadows during night operation. All wheels have been equipped with mud guards; booster brakes furnish additional safety; steering is easier; extra foot room and a higher floor plate add to operator's comfort; newly designed bumper gives more clearance when passing parked cars and doors provide easy accessibility for servicing and inspection. Water tank, filling hose, dirt hopper, chains and sprockets are completely enclosed. To protect operator against the elements, a fully enclosed cab can be furnished.



STREET REPAIR TRUCKS

Portable Asphalt Plants—Dryers
Pug Mixers—Asphalt Kettles
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Finishing Machines

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Joint Installing Machines

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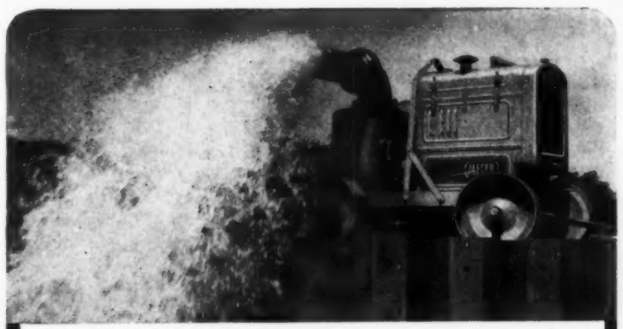
Flexible Road Joint Machine Co.
WARREN, OHIO

DIRT MOVING EQUIPMENT

Highway construction involves more dirt moving than any other branch of engineering construction. ROADS AND STREETS, the only national engineering construction magazine devoted exclusively to, and covering all sections of, the highway field is the most effective and economical medium through which to sell dirt excavating, grading and hauling equipment.



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A Size and Type to Fit Your Job Exactly -- up to 5 Times Faster Priming, Many Other Features

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Contractors use more Jaeger "Factory Tested" Pumps than any other — because they handle air and water easier, always deliver full volume, stand more punishment — and because these finer pumps come in a wider range of sizes, types for every need — portable Centrifugals, Hi-Head Caisson Pumps, Dual Jetting-Dewatering Pumps, Road Pumps, Well Point Systems.

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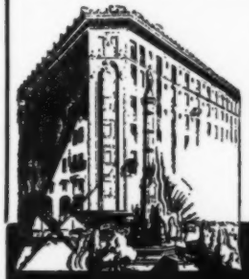

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K. A. KELLY MANAGER

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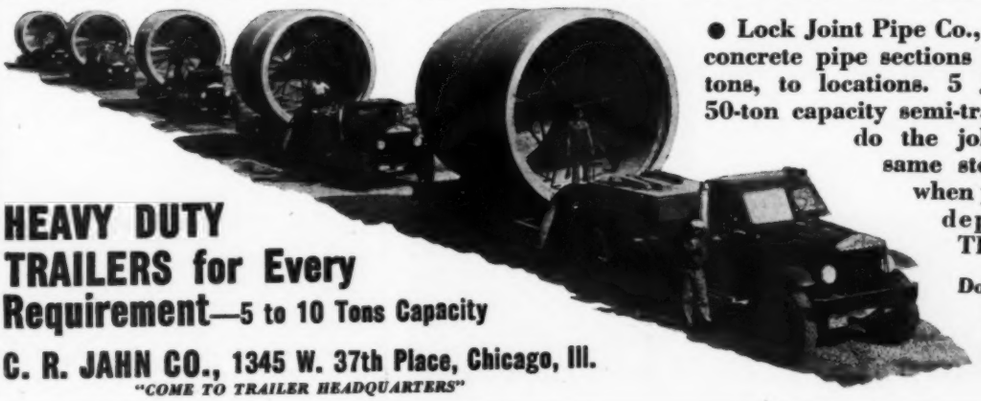
BUFFALO, N.Y.

5 JAHN TRAILERS USED BY LOCK JOINT PIPE CO. on Water Supply Project



● **Lock Joint Pipe Co., transporting 5,300 concrete pipe sections weighing up to 50 tons, to locations. 5 JAHN Heavy Duty 50-ton capacity semi-trailers were used to do the job. You'll find the same story everywhere— when you want to be *sure*, depend on JAHN TRAILERS.**

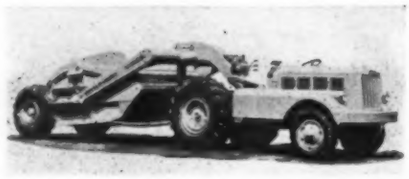
Don't take our word for it — ask any JAHN owner—there's probably one near you. Write for full details.

HEAVY DUTY TRAILERS for Every Requirement—5 to 10 Tons Capacity

C. R. JAHN CO., 1345 W. 37th Place, Chicago, Ill.
"COME TO TRAILER HEADQUARTERS"

New Scraper

A new high-speed hydraulically operated Carrimor scraper has been announced by the LaPlant-Choate Manufacturing Co., Inc., Cedar Rapids, Ia. The new unit is carefully engineered and designed for use with the new rubber-tired tractor of the Caterpillar Tractor Co. It is a high-speed scraper which loads, transports at speeds up to 18 miles per hour, and spreads earth or other material under its own power. It is free from overhead obstructions so that it can be loaded by dragline or shovel, if desired. Fingertip hydraulic control of the scraper matches the hydraulic brakes and steering of the tractor. Hydraulic rear wheel brakes on the scraper are operated simultaneously with the brakes on the tractor. A low center of gravity and correct balance are stated eliminate bobbing, weaving, twisting, and the danger of jack-knifing. The scientific bowed design of the cutting edge makes loading easier and faster. Improved guide arrangement insures correct operation of the rear ejector gate. Another important feature claimed for the scraper is the honeycomb construction of the bowl bottom, an exclusive feature which means much greater strength and rigidity. Another "exclusive" is the independent apron operation. This permits uniform spreading of any material from sand to gumbo. Special features on the hydraulic jacks include chromium plated piston rods to eliminate rusting, pitting, and corrosion, and the jack is designed to prevent foreign material from entering and to eliminate oil leakage. The unit will be called the Carrimor CW-10 Scraper, and has a capacity of 8.75 cu. yd. struck, and 10 yd. heaped.



Carrimor CW-10 Scraper

Parmanco
HORIZONTAL DRILLS

Stop . . . AND THINK!

Parmanco Drills have convinced owners of their true value—

In the Coal field, the Iron range, the Utility and the Contracting field.

We build a model for every need.
Parmanco Drills are now in their fourth year of successful operations.

WRITE US YOUR DRILLING PROBLEMS

PARIS MANUFACTURING CO., INC.
PARIS, ILLINOIS

New A-W Grader

A new motor grader, with hydraulic controls, for jobs that pay out better with a lower investment, without sacrificing the quality of work, has just been announced by The Austin-Western Road Machinery Co., Aurora, Ill. It is powered with a 31 h.p. gas motor; weighs approximately 8000 lb., and uses a sturdy, mono-rail, box-type frame that averages 50 lb., to the foot. It has five speeds forward ranging up to 14.8 m.p.h. and a reverse speed. It is called the No. 55. Scarifier and blade lift are operated by a smooth working accurately built form of hydraulic control such as is used on machines selling at much higher figures. Side shift and circle reverse are hand operated from the cab; steering is very direct and highly efficient. Other design features of interest include a wide front axle with ample ground clearance to straddle windrows; front wheels spaced to track with rear drivers; rugged draft beams with ball-joint connection; large diameter circle and heavily braced blade supports. Standard equipment includes an 8-ft. blade, hydraulic wheel brakes and parking brake. (Electric starter, horn, lights, canopy-type cab, 10-ft. blade, V-type scarifier and snow plow are optional.)

New Austin-Western No. 55 Motor Grader

New 1 Yd.-1¼ Yd. Shovel

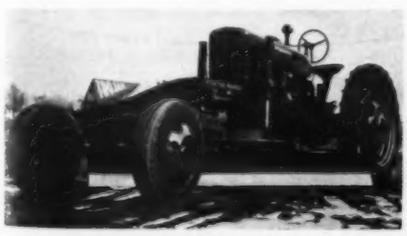
A new standard 1 yd.-1¼ yd. crane-shovel, with very large booster controlled positive main drum clutches and planetary variable speed rotation mechanism, has been added to the line of excavators of the Keystone Driller Co., Beaver Falls, Pa. This Model 19A weighs about 77,000 lb. and is designed for heavy duty, rock and earth excavation and for all types of crane and dragline service with lattice booms 40 ft. to 60 ft. long. The truck

New Keystone Shovel

frame and turntable are one piece castings. Side frames of machined cast steel. Clutches are over-sized for required service and run cool under the maximum loads. Crawlers are smooth running linked plates with ample ground bearing surface, carrying gravity pressure of 11½ lb. per square inch. There are three main shafts only above the deck; all are of exceptional diameter, the main drum shaft being 5.9/16 in. by 4 ft. 10 in. long, mounted on 4 in. roller bearings—and other shafts in proportion. Drum clutches are of the internal expanding type. The crowding device is chain drive to a sprocket on dead center of shipper shaft, eliminating internal torsion. The boom is of the tapered, box girder type, with wide heel hinge and diaphragm reinforcement, the upper half being open to permit the internal carriage and operation of the double dipper handles. Power is supplied by a 4-cylinder heavy duty industrial type engine. Diesel or electric power is optional. Height of boom. door open, boom angle 60°, is 22 ft. 8 in. Dumping radius 26 ft. Traction and steerage through both crawlers, independently reversible. Rotating speed to 5¼ r.p.m.

New Patrol Grader

A new Trojan utility patrol has been brought out by the Contractors Machinery Co., Inc., Batavia, N. Y. The machine is powered by a 40 HP. International engine, and has a range of five forward speeds, inincluding a 16 MPH high for traveling and working speeds of 2½, 3½, 4½ and 5½. The approximate weight is 9,500 lb. and the wheelbase is 14 ft. The machine may be equipped with either single or dual rear wheels and the tread may be adjusted to suit working conditions. Complete control of all blade movements, with exception of side shift, is effected from the operator's platform. Moldboard raising and lowering is controlled through power hydraulic operation, moldboard angling through ground contact, and side shift is manually controlled. An 18 in. side shift either way is possible.



Trojan Utility Patrol

New Tournapulls

Two new Super C Tournapulls, designed for larger, long haul earth moving jobs have been brought out by R. G. Le Tourneau, Inc., Peoria, Ill. Powered by either a 130 or 150 HP. 6-cylinder diesel engine, the Super C utilizes this extra power to increase the production per hour by pulling a

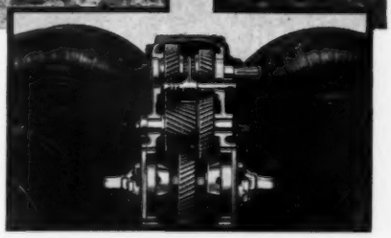
New Super C Tournapull

Model LP Carryall with a struck capacity of 12.1 and a heaped of 15 cu. yd. Standard equipment on the Super C Tournapulls includes hydraulic brakes on both the Tournapull and the Carryall, front crankcase guard with pull hook, front bumper, electric lights, starter, horn and cab. There are no extras to buy. The Tournapull unit is equipped with 2(21.00 x 24) pnuematic tires; and the Carryall Scraper with 2(18.00 x 24). Interchangeable with the Model LP Carryall is the W-10 Tournatrailer with a struck capacity of 9.5 cu. yd., and a heaped of 12.

New 28 In. Intercone Crusher

The Smith Engineering Works has increased their line of reduction crushers by adding a larger size—28 in. This crusher

HERE'S WHERE THE WORK IS DONE!



TRACTION . . .
NOT POWER ALONE
IS WHAT YOU NEED

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When there's heavy work to do, TWO driving axles under the load are better than one. Use the

THORNTON FOUR-REAR-WHEEL DRIVE

YOU SAVE MONEY!

Take a truck of 1½ to 3-tons original capacity and let us quickly and at low cost convert it to a husky unit of 30,000 lbs. or more gross vehicle weight capacity.

Two ratios, for power and speed, easily controlled by a lever in the cab. Walking-Beam Flexibility—Special spring construction keeps equal load on all four driving wheels—Perfect balance between power and weight.

THORNTON TANDEM CO.
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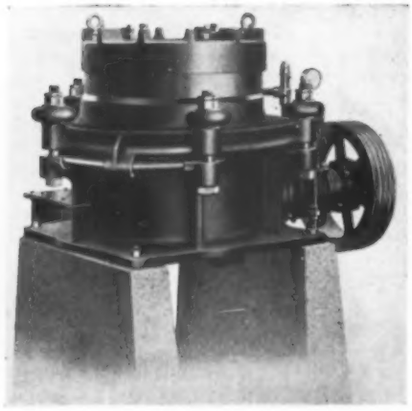
Manufacturers also of the THORNTON automatic-locking DIFFERENTIAL which gives traction when slippery going makes trucks equipped with ordinary differentials helpless.

"When you need TRACTION you need THORNTON"



New 28 In. Telsmith Intercone Crusher

is offered to the producer whose demands call for larger volume capacity but who desires to keep his initial investment in the lower price brackets.

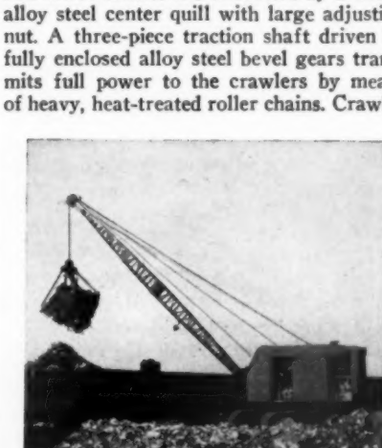
New High Speed Developer

A new BW developing machine designed for greater print production has just been announced by Charles Bruning Co., Inc. Known as the Bruning No. 159 volumatic developer, the machine is designed fo be used with the Bruning Model "75" BW printer. Using this new combination, one operator performs the entire printing and developing operation. In operating the No. 159 volumatic sheet developer, the sensitized paper and tracings are fed into the machine at the front, where they are immediately exposed in the printer section. A vacuum separator roll at the discharge point of the printer separates the tracings from the exposed prints, allowing the prints to pass automatically to the developing and drying sections of the 159 developer. The tracing is returned to the operator, while the completely developed print is delivered flat and dry at the rear of the machine. The No. 159 volumatic developer consists of a separator roll, water roll, and a series of bands which carry the developed prints through the drying section. The applictaion of the positive vacuum separator principle in the developer is entirely new, according to the makers. The developing section is driven by the printer, and is synchronized to operate at exactly the same printing speeds. The "75" printer has a speed range of 0 to 25 ft. per minute.

New BW Developing Machine

New ¾-Yd. Convertible Shovel

A new, lightweight ¾-yd. convertible shovel-dragline-crane, Model 75, has been brought out by Link-Belt Speeder Corp., 301 W. Pershing Road, Chicago, as a companion to its popular LS-85 heavy duty ¾-yd. machine. All-welded steel construction has replaced castings in the new "75." The power plant is a heavy-duty gasoline or Diesel engine with smooth-running roller chain drive. Alloy steel, machine-cut spur gears drive the reverse and drum shafts. These turn in heavy bronze bearings. External band clutches enable the operator to "feel" the load at all times. All brake bands are instantly accessible for adjustment and can be removed easily for re-lining. A large-diameter turntable and long, wide crawlers give the Model "75" extra stability on slopes and in heavy digging. The turntable is made of alloy steel with internal gear. A roller path machined on a bevel permits the use of large, wide-faced conical rollers that revolve without slippage. Upper and lower frames are connected by a heavy alloy steel center quill with large adjusting nut. A three-piece traction shaft driven by fully enclosed alloy steel bevel gears transmits full power to the crawlers by means of heavy, heat-treated roller chains. Crawler shoes are abrasion-resisting, non-clogging, lug driven, with close pin centers to insure smooth action. Added stability results from using double-faced track rollers, increasing the effective crawler width. Track adjustment is provided at both ends to maintain perfect alignment and tension. Controls operated from within the cab permit steering in both directions, either gradual or sharp, regardless of the relative position of cab and lower base. A positive traction lock, controlled from the cab and engaging in three positions, prevents movement of the crawlers while working, eliminating any necessity for chocks or blocking. Working ranges, clearances and lifting capacities are given in a new folder sent upon request. Reader can get a copy by referring to Model "75" and addressing the manufacturer.



Model "75" Equipped With Clamshell Bucket, Loading Refuse Into Cars

Cheaper than wood in the long run
FASTER..BETTER
Blaw-Knox STEEL STREET FORMS will do your street paving work quicker and cheaper. The smooth steel imparts a smooth finish to the concrete, eliminating hand finishing.
Blaw-Knox Forms are built for long service; quick installation and dismantling; and are rigidly braced to hold their position when being filled with concrete.
Blaw-Knox Catalog No. 1527 shows how any design or cross section of work can be accommodated with Blaw-Knox Steel Street Forms. We'll gladly send you a copy.
Always ready for action to build . . .
• Combined Curb and Gutter
• Straight or Battered Curbs
• Integral Curb
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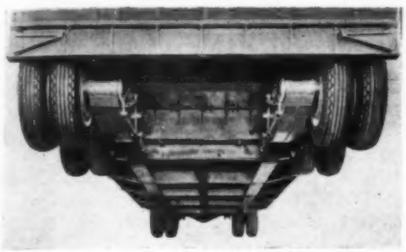
CONCRETE BUCKETS . CLAMSHELL BUCKETS . TRUCK MIXERS . STRIPING MACHINES . TURNTABLES . ROAD FINISHERS . STEEL FORMS

New Rocking Beam Trailer

A recent innovation in the heavy-duty trailer field is the rocking beam trailers brought out by Rogers Bros. Corporation, 110 Orchard St., Albion, Pa. On each side



New Rogers Type "T" Rocking Beam Trailers

at the rear, is a welded box section which rocks lengthwise of the frame. At either end of each section is a short, non-tapering axle which carries a wheel on two heavy-duty Timken bearings. This axle is cambered to fit the normal crown of the road. These Type "T" rocking beam trailers are popular in states wherein the allowable load is based on the number of different axle planes. In these states Type "T" trailers are rated as two axle rear trailers and are therefore acceptable. The design of these Type "T" trailers also permits buildings units only 8 ft. wide in capacities from 15 to 35 tons.

New Instrument for Indicating Slopes

During the 1940 construction season several Minnesota contractors obtained excellent results from the use of the automatic slope indicating instrument illustrated below. This slope-meter is mounted

Automatic Slope-Meter

directly on scrapers, graders, bulldozers and tractors and is designed to show the exact slope the machines are constructing. It is intended to show operators exactly where to cut, spread or finish slopes, this eliminating the tendency to guess.

WITH THE MANUFACTURERS

Boss Made Manager Pigment Sales for Columbia Chemical Division

Dr. A. E. Boss has been named manager of pigment sales of the Columbia Chemical Division of the Pittsburgh Plate Glass Co. He formerly was manager of the technical service department and he will establish headquarters in New York. He will devote his time to the further development of Calcene sales and the establishment of a new program in the interest of Silene, a calcium silicate pigment.

Jay E. Morris Dies

Mr. Jay E. Morris, retired, formerly manager of the Streets and Roads Department of the Barber Asphalt Corporation, died at his home, 319 South Reeves Drive, Beverly Hills, Calif., on Feb. 4 after a brief illness.

New Independent Pneumatic Tool Building in Philadelphia

A new Thor building in Philadelphia at the corner of 17th and Fairmount Ave. will become headquarters for the Philadelphia branch of the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., manufacturers of Thor portable power tools. The transfer of the Thor branch to this new location is expected by the end of March. This new Thor structure is a further step in a building program in which the company has been engaged for the past year, and which includes the erection of a new $500,000 plant in Los Angeles, Calif.

Lincoln Appoints Sales Engineer at San Francisco

The Lincoln Electric Co., manufacturer of arc welding equipment, Cleveland, O., has appointed Stewart J. Hieronymus as sales engineer with its San Francisco office. Prior to his appointment, Mr. Hieronymus was associated with Cutler Hammer, Inc., for 12 years. He has had broad experience in the industrial field which will assist him in serving users and pros-

SISALKRAFT

STOPS THEM ALL

Before They Stop You

Nothing else as practical and economical for covering up—closing in—keeping work going in spite of the weather.

SISALKRAFT is the tough, waterproof, windproof, sisal-reenforced paper of endless uses. For example:

Temporary closures — steam-curing concrete — covering machinery and materials — covering aggregate to be heated by steam.

Available in rolls and blankets of almost any width. Inexpensive and durable. Have some on every job!

Write for Prices, Sizes and Samples.

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New York . . . . . 101 Park Avenue
San Francisco . . 55 New Montgomery St.

CUT COSTS of material handling **WITH... Brooks LOAD LUGGER**

Wherever loading is done by hand.

Use the Brooks system on your road jobs . . . it is the fast modern method of hauling and dumping continuously . . . without costly delays or idle time. The Load Lugger transports the buckets while the men are filling empties. Savings run 50% to 60% and the daily yardage handled is often doubled.

SPECIAL INTRODUCTORY OFFER

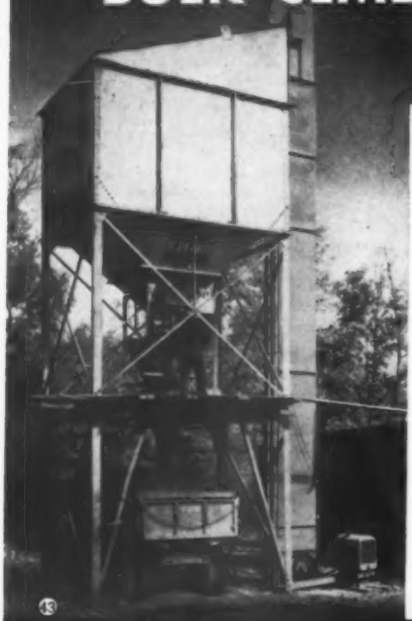
Three weeks' trial of the Load Lugger on your own work . . . just to prove it can show you a big saving in costs.

Brooks EQUIPMENT AND MFG. CO.

KNOXVILLE 503 Davenport Road TENNESSEE

Distributors in all Principal Cities

Facts and Figures on use of BULK CEMENT show SAVINGS of $40.00 per day



Astounding economies are possible through the use of properly designed and built—*trouble-free*—Blaw-Knox Portable BULK CEMENT PLANTS.

Data is available showing how users gain real money savings over the old methods of using bag cement—all through the use of this self-contained, efficient plant which unloads, elevates, stores, accurately weighs batches, and loads bulk cement into trucks, truck mixers, etc.

Blaw-Knox Bulk Cement Plants are furnished complete—nothing else to buy.

Send for these interesting facts and figures on the economy of using bulk cement. Yours for the asking.

BLAW-KNOX DIVISION
OF BLAW-KNOX CO.
FARMERS BANK BUILDING · PITTSBURGH, PA.

Blaw-Knox *Portable . . .*
BULK CEMENT PLANTS

BLAW-KNOX BINS AND BATCHERS · ROAD FORMS · STREET FORMS · CONCRETE SPREADERS · TAMPING ROLLERS · VIBRATORS
CONCRETE BUCKETS · CLAMSHELL BUCKETS · TRUCK MIXERS · STRIPING MACHINES · TURNTABLES · ROAD FINISHERS · STEEL FORMS

pective users of arc welding in manufacture, construction and maintenance in the San Francisco territory. In his new work Mr. Hieronymus will be associated with L. P. Henderson, manager of the San Francisco office together with C. E. McClure and W. F. Fischer.

Seth Klein Joins Marmon-Herrington

Seth Klein has been appointed assistant to the vice president of Marmon-Herrington Co., Bert Dingley. Starting as purchasing agent of the Cole Motor Car Co. in 1912, Mr. Klein has been identified with leaders of the industry ever since that time. Every 500 mile race at The Indianapolis Motor Speedway since the first in 1911, has found Seth Klein on hand in some official capacity, and this will be his 22nd year as starter of the great classic. Mr. Klein was associated with The Fedders Mfg. Co., radiator manufacturers for 19 years. For the past 8 years he has been sales manager of the Detroit Gear and Machine Division of the Borg-Warner Corporation of Detroit.

C. R. Messinger of Chain Belt Co. Dies

C. R. Messinger, President of Chain Belt Co., who has been continuously identified with Milwaukee and Chicago business interests for more than three decades, died suddenly of a heart attack on Feb. 4, 1941, at his home in Milwaukee. His death followed that of Mrs. Messinger by approximately a month.

In addition to being president of Chain Belt Co., Mr. Messinger was chairman of the boards of Oliver Farm Equipment Co., Chicago, and Sivyer Steel Casting Co., Milwaukee. He was a director in several other companies, and assistant chief of the Chicago Ordinance District. His various business connections were as follows:

President—Chain Belt Co.

Chairman of the Board—Oliver Farm Equipment Co., Sivyer Steel Casting Co.

Director—Interstate Drop Forge Co., Federal Malleable Co., Milwaukee Gas Light Co., Continental Casualty Co., Continental Assurance Co., Poor & Co., Chicago Corporation, Roberts & Schaefer.

Mr. Messinger was born in New Haven, Conn., Oct. 28, 1883 and was the son of Charles F. and Helen Beecher Messinger, also natives of that state. He attended New Haven grade schools, the Boardman high school of New Haven, and was graduated from Sheffield Scientific School of Yale University in 1906. In 1911 he married Mildred Hart of Cleveland, O. There were three sons—John, William and Grant, and one daughter, Jane, all of whom survive the parents.

Mr. Messinger's initial business experience was in the plant and sales department of the Harbison-Walker Refractories Co. of Pittsburgh. In 1909 he was in charge of Harbison-Walker's Chicago office, but left that company to become secretary of the Sivyer Steel Casting Co. at the time of its organization. He later became vice-president and general manager, then president and general manager, and was chairman of the board at the time of his death.

At the beginning of 1917 he became affiliated with Chain Belt Co. as it vice presi-

"BERG"
Hi-Way Surfacers

Model H-8

The **"BERG"** is a fast, efficient, **one-man machine,** furnished in two gasoline engine driven models—with and without clutch.

Indispensable for grinding uneven expansion joints and for removing "bumps" and surface variations on concrete roads and streets. Also used on concrete floors, airport runways, slabs and other concrete paving.

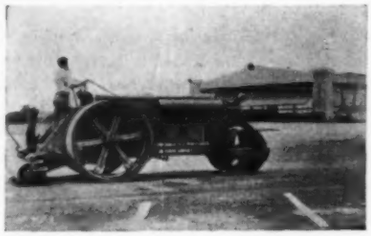
The Power Take-Off is an **exclusive feature,** permitting attachment of "BERG" flexible shaft equipment for surfacing walls, bridges, culverts, etc.

We also manufacture Concrete Surfacers and Vibrators.

Write Dept. C

THE CONCRETE SURFACING MACHINERY CO.
CINCINNATI, OHIO

HERCULES



* Ironeroller *

It levels as it rolls—no more cross-rolling or forty-fiving.

WRITE FOR NEW CATALOG

6 to 12 Ton
Gas or Diesel

THE HERCULES COMPANY
MARION - OHIO

dent and general manager; he had been named a director the year before. Seven years later, in 1923 he was elected president of Chain Belt Co., and in 1931 became chairman of the board. Late in 1934, on the death of Clifford F. Messinger then president of Chain Belt Co., Mr. Messinger returned as its president and has been its executive head since.

In 1931 Mr. Messinger was elected President of Oliver Farm Equipment Co. and in 1935 was named chairman of the board.

In addition to his business connections he was interested in various civic, charitable and educational undertakings, and at the time of his death was a director of the Milwaukee Community Fund, Milwaukee Country Day School, and Columbia Hospital of Milwaukee. He was vice president of the Yale Engineering Association and a member of the executive committee of the Yale Alumni Board, finance committee of the Milwaukee Children's Hospital, Chi Phi Fraternity, Sons of the American Revolution, and the American Society of Mechanical Engineers.

James H. Deaderick Promoted by Caterpillar

James H. Deaderick, who has been assistant sales manager of the western sales division of Caterpillar Tractor Co. since 1939, has been appointed company's assistant general parts manager. Mr. Deaderick, whose headquarters have been at "Caterpillar's" San Leandro, Calif., offices, has been transferred to Peoria, Ill. In his new capacity, under the general managership of L. G. Morgan, Mr. Deaderick will have active charge of all general administrative activities in the Parts Department, as well as supervision of all Parts Depots. W. B. Gordon has been appointed parts manager in charge of physical inventory and its control; and A. H. Yingst, Parts Manager in charge of orders, invoicing, distributor contact, etc. Born in Santa Barbara, Calif., Mr. Deaderick attended grade and high schools there. He studied at the engineering school of the University of California until 1925, when he left college to engage in the contracting business. In 1929, he entered the employ of Caterpillar Tractor Co. as a member of the service department at San Leandro. A year later, he was sent to the Peoria service department. In September, 1933, he became assistant service manager, and returned to San Leandro in the following year as western service manager. He held this position until his appointment as assistant sales manager of the western division.

Ransome Appoints New Representatives in Michigan

The Ransome Concrete Machinery Co., Dunellen, N. J., has appointed T. G. Abrams, Dearborn, and the Anderson Equipment Co., Grand Rapids, as new agents. They will handle the sale of Ransome pavers, mixers, truck mixers, agitators and other Ransome products with the exception of 7-S mixers and smaller in their respective territories in the state of Michigan. The Michigan Equipment Co., Detroit, will handle 7-S and smaller mixers only.

WELDED
ROLLED STEEL CONSTRUCTION for GREATER STRENGTH and SPEED

LOWER HEAD ROOM
L-O-N-G-E-R R-E-A-C-H

Welded Construction insures longer wear—less breakage. Cutting down unnecessary weight means faster work—more yardage. Williams sheave arrangement keeps leads straight, less friction and fraying—longer cable life. Sheaves protected against contact with bucket load, open end sheave block prevents clogging.

Bulletin describing each type of Williams Bucket FREE on request.

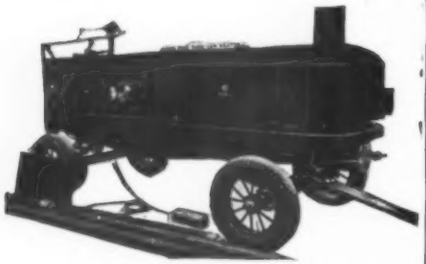
Prompt deliveries and service through nation-wide distributors.

THE WELLMAN ENGINEERING CO.
7003 Central Ave. Cleveland, Ohio

WILLIAMS *Buckets*
built by WELLMAN

GRACE
2-WAY AXLE DRIVEN SWEEPER

RAPID FIRE HEATER



- *Grace 2-Way Axle Driven Sweeper*—the modern traction driven sweeper that successfully meets the sweeping problem of any contractor.
- *Rapid Fire Heater*—A fast-pumping, fast-heat circulating heater that heats 10,000-gallon insulated cars at 40-50° per hour. Write for information and prices.

W. E. GRACE MFG. CO. 6000 Holmes St. DALLAS

For reducing
ROAD MACHINERY MAINTENANCE . . .

The SELF-LOCKING NUTS that can't be loosened by vibration or hard service

. . . specify them on new equipment and use them for replacement.

- Folder explaining the Elastic Stop principle is worth writing for.

ELASTIC STOP NUT CORPORATION
2322C VAUXHALL ROAD • UNION, NEW JERSEY

Elastic Stop SELF-LOCKING NUTS

B. F. Affleck Given Honorary Membership in American Concrete Institute

B. F. Affleck, retired, former president of Universal Atlas Cement Co., was awarded a certificate of honorary membership in the American Concrete Institute at its 37th annual dinner in Washington on February 19. In the long history of the institute, only twelve people have previously been selected for honorary membership which according to the by-laws is conferred upon "a person of eminence in the field of the Institute's interest or one who has performed extraordinary meritorious service to the Institute." Mr. Affleck attended the Institute's first convention in Indianapolis in 1905, has taken a continuous active interest since then, and served two terms on the board of direction.

New Gar Wood Distributors

W. H. Hammond, Sales Manager of the Hoist and Body Division of Gar Wood Industries, Inc., Detroit, Mich., has announced the recent appointment of the following hoist and body distributors: W. T. Stringfellow & Co., 125 12th Ave., North, Nashville, Tenn.; Southern Equipment and Tractor Co., Inc., P. O. Box 1892, Monroe, La.; Oden Equipment Co., 312-24 North 4th St., Albuquerque, N. Mex.; and the Fruehauf Trailer and Equipment Co., 1943 4th Ave., South, Seattle, Wash.; and 906 N. E. 3rd Ave., Portland, Ore.

Barber Asphalt Products To Be Handled by The Highway Co.

The Barber Asphalt Corporation of Barber, N. J., announces that The Highway Co. with offices at Zionsville, Ind., will handle the exclusive sale, within the state of Indiana, of all of its products for the construction and maintenance of streets and highways, including Trinidad native lake asphalt. The Highway Co. will operate under the management of C. G. Alfs, who has a long and successful experience in selling road building materials.

Addison C. Armstrong Joins Worthington

Addison C. Armstrong has joined the Worthington Pump and Machinery Corporation's organization at its Holyoke, Mass., Works, as manager of the Ordnance Division. He will be directly in charge of the production of ordnance equipment at that plant. Mr. Armstrong was formerly affiliated with the Truscon Steel Co. as a departmental manager. Previous to that he was associated with the Bartlett-Hayward Co. and the Campbell Metal Window Corporation, both of Baltimore, Md.

W. F. Munnikhuysen Elected Vice President Koppers Co.

W. F. Munnikhuysen has been elected vice president of Koppers Co. and general manager of the Wood Preserving Division. He formerly was president of The Wood Preserving Corporation, a Koppers subsidiary, which recently became a division of Koppers Co. H. R. Condon and E. J. McGehee, formerly vice presidents of The Wood Preserving Corporation, have been made vice presidents of Wood Preserving Division of Koppers Co. These officers all will be located in the Pittsburgh general offices of the company. D. C. Jones, Chicago, Ill., R. P. Jackson, Texarkana, Tex., and E. S. Park, Nashua, N. H., are district vice presidents in their respective territories. All sales, plant and production department personnel of the Wood Preserving Division of Koppers Co., operating in 26 states, will continue activities of the predecessor company, The Wood Preserving Corporation.

Chain Belt Elects Merwin President

At the annual meeting of the board of directors of Chain Belt Co., Milwaukee, Wis., J. C. Merwin, vice-president and treasurer, was elected president of the company to succeed C. R. Messinger who died Feb. 4th. G. M. Dyke, assistant treasurer, was elected treasurer and A. F. Kessler, also an assistant treasurer, was elected to the new office of comptroller. Walter Kasten, president of the First Wisconsin National Bank of Milwaukee, was made a director at the annual stockholders' meeting which preceded the directors' meeting. Mr. Merwin joined the Chain Belt organization in 1917 and has been successively superintendent, works manager, assistant to president, director, vice-president and treasurer. He is a graduate of Sheffield Scientific School of Yale University, class of 1910, and began his business career as an apprentice tool maker at the Geometric Tool Co. of New Haven, Conn. Later, he was assistant superintendent of the National Blank Book Co. of Holyoke, Mass. Both Mr. Dyke and Mr. Kessler have been connected with Chain Belt Co. since 1923. When Chain Belt acquired the Stearns Conveyor Co. of Cleveland, O., in 1926, Mr. Dyke was elected vice-president of this subsidiary but returned to Milwaukee in 1933 when the operations of the Stearns Conveyor plant were moved there. Since that time he has been assistant treasurer. Mr. Kessler was chief accountant prior to becoming assistant treasurer in 1938.

Trinity Portland Cement Co. Now Manufacturing White Portland Cement

S. W. Storey, Vice-President of the Trinity Portland Cement Co. at Chicago, announces that the company is now engaged in the manufacture of white portland cements, plain and waterproofed. These products will be manufactured at the company's Houston, Tex., mill and will be distributed throughout the entire country as well as to foreign markets. Sales of these cements will be under the immediate direction of Paul F. Keatinge, long identified with the white cement business and well known to architects, contractors, and concrete products manufacturers. Mr. Keatinge has been closely identified with various trade associations and was formerly a vice president of the Producers Council, Incorporated. Trinity white portland cements supplement the company's line of products which include standard gray, high early strength, oil well, and masonry.

SENTINELS of the night

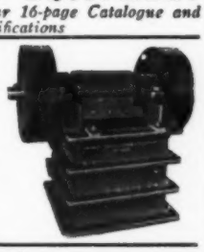
Pennsylvania Turnpike outlined with Cataphotes

Public Works Installed Cataphotes on
Pennsylvania Turnpike—Delineators
San Francisco Bay Bridge—Lane Markers
Golden Gate Bridge—Lane Markers
Selected on basis of Brilliancy and Permanet Reflection.
In the Interests of Public Safety Reduce Accidents—Insist on Cataphotes. They last a Life-Time.

Western Cataphote Corporation
960 Wall Street Toledo, Ohio

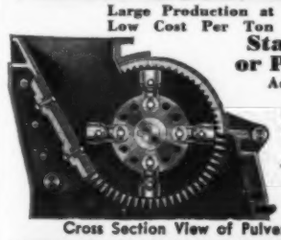
LOW COST CRUSHING FOR 55 YEARS
For Large Capacity you can depend on
GRUENDLER EQUIPMENT
FREE—Write for our 16-page Catalogue and Specifications

Bronze or Roller Bearing
JAW CRUSHERS
Heavy Armor plate steel or cast steel Constructed
Large capacity
Small power Requirements



STRAIGHT LINE ROCK AND GRAVEL CRUSHING AND SCREENING PLANTS

LIMESTONE PULVERIZERS
Large Production at Low Cost Per Ton
Stationary or Portable
Adjustable
Crushes Large Stone to 2" minus
Down to Agricultural Dust
Built In (8 Sizes)



Cross Section View of Pulverizer

GRUENDLER
CRUSHERS · PULVERIZERS · GRINDERS
GRUENDLER CRUSHER & PULVERIZER CO.
2915-21 N. Market St., St. Louis, Mo.

Remove Offices to Uniontown, Pa.

Amiesite Corporation of Pennsylvania and American Sealdrok, Inc., have removed their offices from 1601 Architects Bldg., Philadelphia, to Suite 609, Fayette Title & Trust Bldg., Uniontown, Pa.

Clyde Everett Now New England Manager for Buffalo-Springfield

Clyde Everett has been appointed New England manager for the Buffalo-Springfield Roller Co., with headquarters at 11 Carleton St., Cambridge, Mass. Mr. Everett has been with the company for 15 years.

NEW TRADE LITERATURE

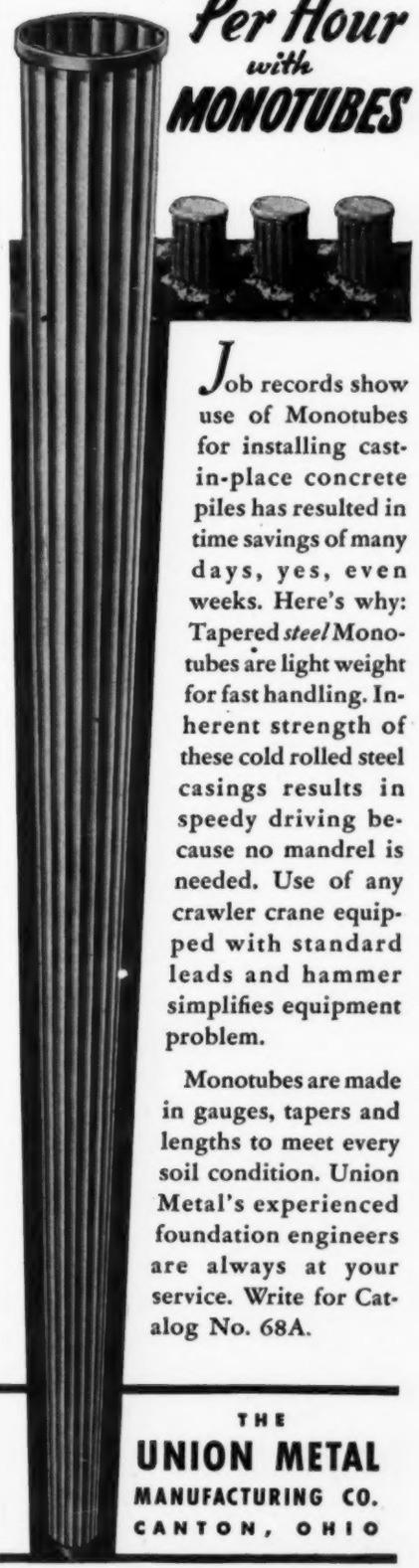
Longitudinal Finisher.—A new catalog illustrating and describing its longitudinal finisher has been issued by the Koehring Co., 3026 West Concordia Ave., Milwaukee, Wis. The catalog not only describes the construction features but it also illustrates the application of this modern mechanical tool, for preparing the surface of the concrete highway slab. The many illustrations and accompanying explanations take the reader step-by-step from the beginning of construction to the operation of the machine. Copies can be obtained writing to the manufacturers.

Friction Materials.—In a new illustrated brochure, "Industrial Friction Materials," Johns-Manville has gathered together comprehensive data on the complete lines of industrial brake linings and blocks and clutch facings which it manufactures for all types of industrial equipment. The most important feature of this brochure is a chart which simplifies the selection of the most suitable friction material for any specified service. Supplementing this technical chart is another showing recommendations for specific types of clutches and brakes; also a third table giving the coefficient of friction, size limits, thickness, tolerances and recommended service conditions for each of the various types of J-M industrial brake linings and blocks and clutch facings. Copies of this brochure, Form FM-7A, are available upon request to Johns-Manville, 22 East 40th St., New York City.

Cold Weather Concreting.—A revised 12-page bulletin on "Cold Weather Concreting, High Early Strength and Better Concrete Curing" has recently been issued by the Calcium Chloride Association, 4145 Penobscot Building Detroit, Mich. Containing detailed information on the effects and advantages of adding calcium chloride to concrete mixtures, the bulletin is also well illustrated with photographs and charts. Included are the latest A.S.T.M. specifications for using calcium chloride in dry flake form, as well as in solution, covering the incorporation of the chemical as an admixture and its use as a surface curing agent. Copies of this interesting bulletin are available without charge to all interested persons upon request addressed to the Calcium Chloride Association.

Precision Manufacturing Methods.—In a new booklet about precision manufacturing methods, which has just been issued by Caterpillar Tractor Co., there is a clear view of the care and accuracy that is necessary to produce machines that meet that

You Can Install More Piles Per Hour with **MONOTUBES**



Job records show use of Monotubes for installing cast-in-place concrete piles has resulted in time savings of many days, yes, even weeks. Here's why: Tapered *steel* Monotubes are light weight for fast handling. Inherent strength of these cold rolled steel casings results in speedy driving because no mandrel is needed. Use of any crawler crane equipped with standard leads and hammer simplifies equipment problem.

Monotubes are made in gauges, tapers and lengths to meet every soil condition. Union Metal's experienced foundation engineers are always at your service. Write for Catalog No. 68A.

THE
UNION METAL MANUFACTURING CO.
CANTON, OHIO

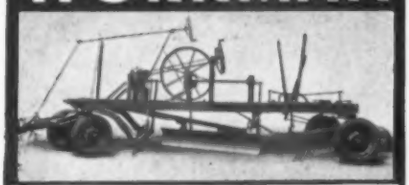
A BURCH
ON THE JOB

A BURCH FORCE FEED SPREADER on the job will insure an even, uniform stone mat. Specially designed cylinder will eliminate corrugating, dual feed gate control gives a wide range of adjustment to the flow of material. The machine is operated by the movement of the truck forward or backward. It is anti-friction bearing equipped throughout.

Manufactured by
THE
BURCH CORPORATION
Crestline, Ohio
Builders of equipment for Fifty Years

SNOGO
For Complete Snow Removal
ELIMINATES dangerous one way bottlenecks. Reduces expensive repeat plowing. Reduces snow damage to roads, and cuts resulting road repair. Plan now for real snow removal next winter.
Klauer Manufacturing Co.
DUBUQUE IOWA

MASTER
WORKMAN



For Better Roads, put a WORKMAN Machine on the job. 3 sizes:
THE GENERAL • THE SUPER
THE MASTER
YORK MODERN CORPORATION
UNADILLA, NEW YORK

company's rigid standards. "Caterpillar's" instruments and methods—many of which are photographed and publicized for the first time—work to within a few millionths of an inch of absolute accuracy. The machines and gauges which are necessary for this kind of production are discussed and photographed. Superfinishing of crankshafts, gear manufacturing to one ten-thousandth of an inch of accuracy, pre-testing of steels, track link accuracy, chromium plating twenty times as thick as that used for decoration, and numerous other "Caterpillar" practices are described. A chapter is devoted to metal hardening by high frequency induction. Foundry practices and the maintenance of welding quality are among the other things discussed. The two color booklet is profusely illustrated, and is written in easy to understand language, with technical terms avoided wherever possible. Copies may be obtained, free of charge, by writing Caterpillar Tractor Co., Peoria, Ill., and requesting Form 6231.

Concrete Culverts and Conduits—Particular attention is given in this 54 page booklet, a publication of the Portland Cement Association, to the design requirements of the practical engineer. The fundamental theory is concisely treated, emphasis being directed to modern methods by which drainage structures are economically chosen, properly located and correctly designed. Starting logically with the determination of maximum run-off, the engineer is taken step-by-step through pertinent discussions on selection of culvert or conduit types, design loads, short-cut design procedures, and detailed examples. New and valuable data include the results of extended analyses, in the form of coefficients for the design of both box-culvert and sewer sections. Typical designs are also presented to meet a wide range of field conditions. Copies may be had free in the United States and Canada upon request to the Portland Cement Association, 33 West Grand Ave., Chicago, Ill.

Truck Mixer Charging Plants.—A 16 page bulletin illustrating and comprehensively treating various types of Heltzel truck mixer charging plants has been issued by The Heltzel Steel Form and Iron Co., Warren, O. Descriptions and illustrations are given of the 30-45 ton highway bin, the Type 1 portable bins, wedge type bolted bins, bulk cement tanks, portable bulk cement plant, semi-portable bulk cement batching plant, and enclosed bucket elevators. Line drawings are included as well as tables of dimensions.

Highway Widening Machine.—A bulletin has been issued by The Buckeye Traction Ditcher Co., Findlay, O., describing the two models of the Buckeye highway widening machine. Basically, the Buckeye road widener is similar to a wheel type trencher, but it is truck-mounted and is used for digging subgrade widening trench. The bulletin describes the Model 16-R-2 machine, which will cut trenches from 12 in. up to 35 in. in width and up to 12 in. in depth, and the model 16-R-4, which will cut trenches from 12 in. up to 48 in. wide and up to 12 in. deep. The bulletin shows operating pictures of the units and complete specifications.

Bituminous Mixing.—"1940 Performance Data and Laboratory Reports" is the title of a new booklet just issued by Barber-Greene Co., Aurora, Ill. It is chiefly a report on four carefully separated central plant bituminous jobs applying the continuous production principle of the Barber-Greene mixer to the "higher type" bituminous mixes. Each plant was equipped with a Barber-Greene gradation control unit for separating and proportioning three sizes of aggregate separately. The contents of the booklet are divided as follows: 1. Essential facts on four actual jobs followed by laboratory mix analyses made from job extraction tests. 2. Fundamental principles of continuous mixer, including flow diagram of complete plant and discussion of detailed operations. 3. Simple inspection control assuring consistent results. 4. Advantages in quality, cost, and versatility. 5. Suggested specifications both by results and by method. Copies of the booklet will be sent to anyone writing Barber-Greene Co., Aurora, Ill.

REFLECTO PRODUCTS
New Luminous
REFLECTO CHAIN
for National Defense
Reflects and also glows in darkness. Quick, easy, inexpensive way to "make your own" reflector markers, and military traffic signs.
SURFACE MARKERS
for Streets and Highways
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